VOL. Ia

CONSERVATION ELEMENT

OF THE

ALAMEDA COUNTY GENERAL PLAN

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Adopted By
Alameda County Board of
Supervisors
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1 - CONSERVATION ELEMENT

I. INTRODUCTION

A. Authority

Government Code Section 65302 (d) requires a conservation element of all city and county general plans, as follows:

> A conservation element for the conservation, development, and utilization of natural resources including water and its hydraulic force, forests, soils, rivers and other waters, harbors, fisheries, wildlife, minerals, and other natural resources. That portion of the conservation element including waters shall be developed in coordination with any county-wide water agency and with all district and city water agencies which have developed, served, controlled or conserved water for any purpose for the county or city for which the plan is prepared. The conservation element may also cover:
>
> (a) the reclamation of land and waters.
>
> (b) flood control.
>
> (c) prevention and control of the pollution of streams and other waters.
>
> (d) regulation of the use of land in stream channels and other areas required for the accomplishment of the conservation plan.
>
> (e) prevention, control and correction of the erosion of soils, beaches and shores.
>
> (f) protection of watersheds.
>
> (g) the location, quantity and quality of the rock, sand, and gravel resources.

The conservation element of the County's General Plan is a long-range plan with the following major goals:

- quality in the natural resource base;
- quality in the environment to provide attractive, safe, and satisfying places to live, work, and plan; and
- quality in the standard of living.

B. Components of the Conservation Element

The planned management of resources in Alameda County involves research in several areas:

- identification of natural resources;
- assessment of the degree of development and utilization of those resources;
- identification of areas of critical concern;
- determination of the carrying capacity or development potential of each resource;
- establishment of development and utilization criteria for each resource; and
- development of goals and policies for resource conservation;
- design of implementation program.

In a metropolitan county such as Alameda County, a significant portion of the flat area has been committed to urban and industrial uses, often without consideration of consequences to natural resources. Economic decisions for resource development and conservation must be carefully examined in the future to prevent further deterioration of the environment. Decisions on resource development must be balanced with the need for preserving and maintaining a diverse and aesthetic environment. The objective of the conservation element is to provide economic and environmental information critical to the development of resources, land use, and the preservation of environmental balance. It should also provide an education as well as sensitivity to valuable renewable and non-renewable resources.

C. Methods

The California State Office of Planning and Research has issued guidelines for the preparation of the Conservation Element of the General Plan and in those Guidelines established a general methodology for developing the conservation element. The resources which are to be discussed in this conservation element are only limited by those resources present in Alameda County. The natural resources included for consideration here are:

- Physiographic, topographic, and geologic resources
- Agriculture and soil resources
- Vegetation and wildlife resources
- Water resources
- Mineral resources
- Other natural resources such as air.

Once the above resources have been adequately identified, the relationships between the resources will be analyzed and the areas of critical concern identified. The State Guidelines also indicate that the carrying capacity and development capacity of various land areas should be developed with the goal of minimizing the ecological disruption and conserving natural resources. The implication here is that the assessment of natural resources within an area should include a consideration of renewable and non-renewable nature of the resource. Indeed this approach will be utilized in addition to designation of certain areas of the County as "Resource Management Area."

D. County-City Coordination

The major portion of County-City Coordination in the Conservation Element has taken place in the Solid Waste Management Technical Advisory Committee 1973-1975 which is described in the Preface to this element (page P-1). Other coordination has taken place in the preparation of the Hayward Area Shoreline Policies with the City of Hayward, also described in the preface.

II. INVENTORY OF RESOURCES

A. Physiographic Description of Alameda County

Alameda County is located on the east side of southern San Francisco Bay. Within its boundaries is 735 miles of land and 77 square miles of bay. Elevations range from sea level along the 36 miles of bay shoreline to 3,817 feet in the Diablo Range south of Livermore. The County is approximately thirty-two miles in length in a north-south direction and 45 miles in width in an east-west direction. The County is a diverse combination of land types and forms ranging from salt water marshes along the bay plain to moderately high uplands and intermontaine valleys. Thus, the climate varies from a marine type along the bay fringes to fog-shrouded Redwood forest in the East Bay Hills, to arid range sites of open grassland savannah in the portion of the County adjacent to the San Joaquin Valley. Conditions vary depending upon the mean sea level, altitude, and the topography, as well as the distance from the ocean and bay.

The Bay Plain varies from three miles in width at the north end of the County, in the Berkeley-Albany area, to eight miles at the south, near Fremont. The bay plain is composed of geologically recent fluvial and alluvial deposits of the late Cenozoic period. In this portion of the County is located the major portion of the high density urbanization which comprises the urban core of the Eden and Central Metropolitan Planning Units. The southerly and less densely populated part of the bay plain still retains much of the rural character of the past, although this is rapidly disappearing around the cities of Fremont, Newark, and Union City. In the South Bay vicinity are tidal flats and marshes, salt ponds, the Alameda Creek-Coyote Hills Regional Park, and portions of the South San Francisco Bay National Wildlife Refuge Complex.

East of the Bay Plain are the East Bay Hills which are a part of the western and central portion of the Diablo Range. The County extends east through the Diablo Range to the western edge of the San Joaquin Valley. Within this area is located the Livermore and Amador Valleys, which are the largest of the intermontaine valleys in the coastal range. The eastern portion of the County varies from gently rolling terraces and alluvial plains to the steep to very steep V-shaped upland areas Well used and possibly historic trade routes, now permanent interstate freeways, exist through natural passes located east of Hayward, through Dublin Canyon and through Mission Pass in the Mission Hills east of Fremont. The highest points in the East Bay Hills are Monument Peak, 2,594 feet, and Mission Peak, 2,517 feet, both east of Fremont. The East Bay ridge provides a dramatic background for San Francisco Bay and the coastal plain on the west slopes and a scenic background on the east slopes for the Livermore-Amador Valley. The large intermontaine coastal valley, the Livermore and Amador Valley, is separated from the bay plain by eight miles of foothills in the north, east of Castro Valley, and about four miles in the Mission Pass area.

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
CENTRAL DISTRICT

GENERALIZED GEOLOGIC AND GROUND WATER MAP OF ALAMEDA COUNTY

WATER-BEARING UNITS

	Map Symbol
QUATERNARY ALLUVIUM - Includes older alluvial fan deposits, interfluvial basin deposits, younger fluvial deposits, younger alluvial fan deposits, and stream channel material of Upper Pleistocene and Holocene age. Also includes the marine Merritt Sand. Comprises interbedded and intermixed, unconsolidated to semiconsolidated silts, clays, sands, gravels and boulders. Clean sands and gravels have the highest permeability and thus provide the significant aquifers. Conversely, silt and clay layers have low permeability and form confining beds or aquitards.	Q
DEFORMED OLDER ALLUVIAL SEDIMENTS - Include the Livermore and Santa Clara Formations of Plio Pleistocene age and the Tassajara Formation of Upper Pliocene age. Poorly to moderately consolidated stream-laid clays, silts, sands, and gravels with subordinate lake sediments; locally tuffaceous. Tilted, folded, and faulted after deposition. The high percentage of interstitial fines restricts permeability, thus limiting yield to wells.	TQ

NONWATER-BEARING UNITS

	Map Symbol
TERTIARY ROCKS - Include Tesla, Tolman and Tejon Formations of Eocene age. Oursan, Claremont, Sobrante, Monterey, Neroly, Cierbo, Briones, Mambre, and Tice Formations of Miocene age; and the Orinda Formation and Leona Rhyolite of Pliocene age. Pre-Pliocene rocks consist of marine sandstone, siltstone, shale, and conglomerate with some chert, coal, and tuffaceous beds. Potable ground water, if any, occurs where secondary openings have been formed by fractures, joints, and shear zones and where connate brines have been flushed from near-surface rocks. The Orinda Formation includes fresh water deposits of sandstone, conglomerate, siltstone, and claystone with small amounts of tuff and limestone. Abundance of fines makes it essentially nonwater-bearing.	T
CRETACEOUS ROCKS - Include the Oakland Conglomerate and the Niles Canyon, Horsetown, Berryessa, Del Valle, Moreno Grande, Panoche and Chico Formations. Primarily sandstone, shale, conglomerate, and siltstone, all of marine origin. Potable ground water, if any, occurs where secondary openings have been formed by fractures, joints and shear zones, and where connate brines have been flushed from near-surface rocks.	K
JURASSIC ROCKS - marine sedimentary rocks, generally mapped as the Franciscan Formation. Composed primarily of graywacke (sandstone), with smaller amounts of interbedded siltstone and shale. Minor rock types include conglomerate, red and green chert, greenstone, and serpentine. Essentially nonwater-bearing, except where secondary openings have been formed by fractures, joints, and shear zones and where connate brines have been flushed from the rocks.	J

Major ridgelines and peaks (East Bay Ridge, Mount Diablo, Mount Hamilton, and Arroyo del Valle) separates the County into three significant hydrologic units and two areas of minor hydrologic significance. All hydrologic units are extremely important when considering various aspects of water resources management. The hills surrounding the Livermore and Amador Valleys are predominately open primarily devoted to agriculture or some form of recreation. In the extreme northeastern corner of the County, a small flat area extends into the San Joaquin Valley. Some of this area is devoted to agricultural crop production; the foothill portion is similar to the grasslands of the Altamont vicinity and the Great Valley Foothills.

Approximately fifty-six percent of the County contains hills with a slope of twenty-five percent or greater. The distribution of the area of 25 percent or greater slope is 34 percent in the western portion of the County and 72 percent in the eastern portion. With the exception of residential development in the Oakland and Berkeley hills, small developed portions in the Hayward hills, and minor development in the Pleasanton area, the major portion of the East Bay Ridge and Diablo Range in Alameda County remains undeveloped. Most of the undeveloped East Bay Ridge area is shown as open area on the County General Plan; and all the ridges on the north, east, south, and west sides of the Livermore-Amador Valley are undeveloped and shown as open space on the County General Plan. Much of the open use is presently utilized for some form of agriculture, depending on soil fertility, capability, and type.

Central Metropolitan Planning Unit

The Central Metropolitan Planning Unit consists of the cities of Alameda, Albany, Berkeley, Emeryville, Oakland, and Piedmont. In the 1968 Estimate of Existing Land Use, approximately ninety percent of the 51,030 acres in the planning unit were developed and in residential, commercial, industrial, public or semi-public, or vacant uses. All of the land area in the CMPU is incorporated; approximately 5,030 acres are in major parks and recreation uses, and 4,310 acres are vacant urban. The cities occupy the area from the crest of the East Bay Hills to the bayfront, from Albany to the northern limit of San Leandro, in a wide variety of densities and land uses. Approximately fifty-five to sixty percent of the population and industrial activity in the County is located in the CMPU.

Eden Planning Unit

Included in this planning unit are the cities of San Leandro and Hayward and the unincorporated communities of San Lorenzo and Castro Valley. The Eden Planning Unit consists of a total of 76,430 acres of which 27,890 acres are incorporated and 48,540 are unincorporated. Over 38,000 acres of this area are uncultivated and undeveloped. As described previously, the EPU occupies an area between the East Bay Hills and the San Francisco Bay. Most of the development is along the bay plain and is concentrated in the cities mentioned above. The southern portions of the eastern boundary of the planning unit is Sunol Ridge.

Washington Planning Unit

The Washington Planning Unit begins south of Hayward and includes the cities of Fremont, Newark, and Union City; the unincorporated area to the west; and a Rural-Recreation Area to the east of the foothills. The 1968 land use survey showed 91 percent of the 79,280 acres in this planning area incorporated into one of the three cities. In the same survey, 47,310 acres were designated as in agricultural and open uses, while 29,120 acres were assigned to residential, commercial, industrial and other uses. As in the other areas to the north in the County, the predominant area of urbanization in this planning unit is the bay plain between the foothills and the bay. Unique to this area is the Alameda Creek-Coyote Hills Regional Park near the edge of the bay and the adjacent South San Francisco Bay National Wildlife Refuge to the south.

Livermore-Amador Planning Unit

The Livermore-Amador Planning Unit (LAPU) consists of 264,530 acres and represents about 56 percent of the land area in Alameda County. About six percent, or 14,620 acres, is incorporated into the Cities of Livermore or Pleasanton. The boundaries of the LAPU are defined by the County line near Bethany Reservoir to the north and Mt. Boardman to the south, and by Monument Peak to the west and Dublin to the County line at the northwest. The area stretches from the East Bay Hills (Sunol and Pleasanton Ridges) to the Eastern Units of the Diablo Range western edge of the San Joaquin Valley.

Topography within the LAPU is quite varied and ranges from gently sloping lowlands to very steep canyons. Approximately seventy-two percent of the area has a slope of 25 percent or greater. Land-type divisions may be made based upon topography into at least three categories: upland site, terrace sites, or valley or lowland sites. The location of the boundary of each unit is different depending upon the basic information used in the interpretation. Basically, however, the LAPU consists of the northern section of the Diablo Range surrounding the Livermore, Amador, and Sunol Valleys.

B. Generalized Geology of Alameda County:[1]

The general geologic setting of Alameda County is shown on the Generalized Geologic and Ground Water Map of Alameda County. Active and potentially active fault traces are shown on a map in the Seismic Element of the County General Plan.

a) Geology of the Western Portion of Alameda County

The part of Alameda County which lies west of the active Calaveras Fault includes the East Bay Hills from Albany on the north to the Mission District east of Fremont. Also included in this area is the Bay Plain from the base of the foothills to the edge of the San Francisco Bay. The rocks in the hills are older and considerably more complex than the relatively recent alluvial deposits of the Bay Plain. The complexity of the rocks in the hills is a function of their history of deformation and diversity of type and characteristics. For example, in the Berkeley-Albany hills, the following formations have been identified: Mesozoic ultrabasic intrusive rocks, Franciscan, Eocene marine, Plicene volcanic, middle and/or lower Pliocene nonmarine, and Pleistocene nonmarine. As one progresses south in the hills from Oakland to Fremont, the predominant formation becomes a sequence of upper Cretaceous marine sandstones and shales with strips of ultrabasic intrusive and metasedimentary rocks (Mesozoic), Pliocene volcanic, and middle and/or lower Pliocene nonmarine sediments occur along the western base of the hills. The East Bay hills are separated from the Bay Plain to the west by the active Hayward Fault system.

The plain west of the foothills in Alameda County is comprised of Quaternary Alluvial deposits which have washed down from the hills and have been deposited on top of the older rock formations. One may isualize the process of formation of this plain as a progressive accumulation of layers of materials of varying composition and permeability. Some of the layers which have been identified in the Quaternary alluvial deposits have come directly from the hills and some are a result of sedimentation of clays and muds while the area was partially or wholly submerged. This layering has occurred in such a fashion around the creeks pouring into the bay that humps, or cones, have formed at San Leandro, San Lorenzo, and Alameda Creek. These cones which are presently sources of ground water for residential and agricultural uses are called the San Leandro, San Lorenzo, and Niles Cones, respectively.

The alluvial deposits underlying the Bay Plain have been subdivided into several units by the U.S. Geological Survey (Helley and others, 1972) based upon variations in gross lithology and degree of induration.

[1]Adapted from David M. Hill, Geologist, Calif. St. Department of Water Resources for Evaluation of Environmental Constraints for Solid Waste Management

Along the very western edge of the Bay Plain, the geologic formations do not alter appreciably from those mentioned in the previous paragraphs but the combined importance of the geologic, biologic, and man-interference with the bay and tidelands has resulted in both an interesting and sensitive environmental area. The historic marshes are undergoing a change to the characteristic plain, which is observed further inland. Indian shell mounds which were once located on the shores of the bay several centuries ago are now several miles from the shore. The bayshore areas are underlain chiefly by Younger Bay Mud, a predominantly soft gray silty clay (Goldman, 1969). The Younger Bay Mud locally contains lenses of fine, water saturated sand.

b) Geology of Livermore-Amador Planning Unit

The LAPU is located in the northwest-trending coastal range and is predominantly east of the active Calaveras Fault system. There are several unique features about the area. The upland sites which surround the Livermore Valley are composed of geologically older consolidated nonwater-bearing rock formations. This material also forms the foundation of the Livermore Valley at considerable depths. In the uplands area south of Livermore, the Franciscan Formation may be observed. This is the oldest formation and constitutes a major portion of the uplands. The Franciscan Formation is described as "graywacke, locally abundant red and green thin-bedded chert, siltstone and silty shale, minor conglomerate, limestone, blue-grey glaucophane-bearing schist and related metamorphic rocks. The Franciscan Formation in the Diablo Range is generally considered to be of Jurassic and possibly pre-Jurassic age."[1]

In the upland areas around Patterson Pass and the Carnegie Fault, a division occurs between the Franciscan and the younger Del Valle Formations. This area stretches between Corral Hollow and Interstate 580 and is a jumbled mixture of upper Cretaceous marine, upper Miocene marine, and middle and/or lower Pliocene non-marine sedimentary rocks. Recent geologic studies suggest that some of the fault systems in this complex area are potentially active (Wright, 1974).

The region north of I-580 is underlain primarily by upper Cretaceous marine sedimentary rocks similar to those exposed in the East Bay Hills south of Castro Valley to Niles Canyon.

Again in the uplands areas between Niles Canyon and Monument Peak, the Cretaceous and Miocene marine and middle and lower Pliocene non-marine formation units are found interspersed with each other.

[1] "Stratigraphic Nomenclature-San Jose Sheet" in Explanatory Data San Jose Sheet, Geologic Map of Calif. Calif. State Department of Conservation, Division of Mines and Geology, Olaf P. Jenkins Edition, 2nd Printing, 1972 Cedar Mountain and along the portions of Cedar Ridge, Main Ridge and Apperson Ridge.

The upland formations primarily consist of marine sedimentary and meta sedimentary rocks. Only small amounts of igneous rock are apparent. Examples of Mesozioc ultra basic intrusive rocks may be observed in the uplands near the southern end of Del Valle Reservoir and east of Calaveras Reservoir.

The Livermore Valley was formed by an east to west downfold along the Calaveras Fault. The alluvial terraces and plains, recognizable at the mid-level elevations or rolling foothills north and south of Livermore constitute a second broad physiographic division of the LAPU area. This transition zone is divided into two areas based upon geologic units.

The foothills north of Livermore on the south slopes of Mt. Diablo, and in the prominent foothills along Doolan, Collier, and Tassajara Creeks north of Livermore and Arroyo Las Positas are underlain by middle and/or lower Pliocene non-marine sedimentary rocks identified as the Orinda and Neroly Formations.

The Orinda Formation has been subdivided into the Tassajara and Green Valley formations and is characterized by "red, gray, or brown, loosely consolidated sandstone and conglomerate, subordinate amounts of shale, claystone, limestone lenses, and tuffaceous bentonitic clay."[1] The Tassajara Formation, more appropriately associated with this area, consists of "brown to gray mudstone, andesitic sandstone, conglomerate, and minor bentonitic and pumiceous tuff."[1] The Orinda is basically a continental flood plain deposit with discontinuous marine beds at the base.[2]

South of Livermore and Pleasanton the low foothills consist of Plio-Pleistocene non-marine sedimentary deposits of the Livermore gravel formation. The Livermore gravel is characterized by "loosely consolidated sand, gravel, clay, and local tuff beds (contains Pliocene fresh water invertebrate fauna and Pleistocene vertebrate fauna.)"(State of California, 1972.)

The low lands of the Livermore Valley consist of recent alluvial deposits surrounding minor areas underlain by the Orinda and Livermore formations. Surficial portions of the alluvial sequence have been subdivided by the U.S. Geological Survey into several units based on gross lithologic characteristics and degree of induration (Helley and others, 1972). Studies by the California Department of Water Resources (1974) have revealed similar horizontal and vertical variations in the subsurface. Goundwater contained in the recent alluvial deposits and in the Livermore Formation represent a significant resource and minor amounts of ground water have also been produced from the Tassajara formation.

[1] "Stratigraphic Nomenclature - San Jose Sheet" in Explanatory Data San Jose Sheet, Geologic Map of Calif. Calif. State Department of Conservation, Division of Mines and Geology, Olaf P. Jenkins Edition, 2nd Pringing, 1972 Cedar Mountain, and along the portions of Cedar Ridge, Main Ridge, and Apperson Ridge.
[2] Geologic Guide book of the San Francisco Bay Counties Bulletin 154, Calif. Division the Ibid foothills south of Livermore and Pleasanton, of Mines and Geology, 1951 (p. 143).

Within the LAPU, at least 17 faults have been identified. Some show possible evidence of geologically recent movement. Some form groundwater barriers in Pleistocene materials and others appear to be old faults that affect only Pliocene or older bedrock materials.

As mentioned above, the Livermore Valley has developed in an east-west dipping downfold or syncline terminating against the Calaveras Fault and the uplifted Pleasanton Ridge block. At the base of the Altamont Hills is the Greenville Fault which terminates near Arroyo Las Positas. In the southern section of the Altamont Foothills, the Patterson Pass, Tesla, Carnegie, and Corral Hollow Faults are found. The faults run parrallel to each other between the Livermore and San Joaquin Valleys. East of Altamont Pass near Grant Line Road is the Midway Fault which is located in a local depression along Grant Line Road.

The faults found in the upland hills between Tesla Creek and the Mission Hills (Monument Peak) are the Valle, Williams, Verone, Indian Creek, McGuire Peaks, Welch and Calaveras. Among these, the Calaveras and Verone-Williams-Valle Systems appear to be the most prominent.

Within the lowlands of the Livermore Valley, several faults have been identified; they are the Livermore Fault and its branch, the Parks Fault, the Pleasanton Fault and its branches, and the northern section of the Calaveras Fault. In the vicinity of Dublin, the Gravel Pit and the Dublin Faults are observed in the foothills.

Slope:

The greater portion of the Livermore-Amador Planning Unit is in the greater than 30 percent slope category. In the valley lowlands, much of the land is level with from zero to five percent slope. The fringes of the foothills around the entire Livermore and Amador Valleys consist of 5-15 percent slope.

In the foothills north of Livermore around Doolan and Collier Canyon and in the Altamont hills, the slopes are gentle, rarely exceeding 30 percent and generally falling within the 15-30 percent range.

South of Livermore and Pleasanton, the Upland areas of the Diablo Range consist of a high proportion of 30-50 percent slope hills. Some ravines range to nearly 70 percent slope. Within the upland area, there are plateaus and canyons which fall into the 5-15 and 15-30 percent ranges; but these areas are minimal.

Although slope considerations, alone, may severly limit development of a site, interpretation of the degree of constraint is included in the Soils Resources discussion, since interpretation of slope is included as part of the Soil Survey.[1]

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[1]USDA, Soil Conservation Service, Soil Survey: Alameda Area, California, March, 1966.

C. Agriculture and Soil Resources Management

Factors of Soil Formation[1]

Soil has been defined as a dynamic natural body on the surface of the earth in which plants grow; it is composed of mineral and organic materials and living forms. Soils differ in their appearance, composition, management requirements, and productivity within short distances. The factors that influence soil development are 1) climate, 2) living organisms, 3) parent material, 4) relief, and 5) time. Every soil is affected to some extent by all five factors, but the relative importance of each factor in soil development varies from one soil to another.

Climate.--The climate of the Alameda County Area is of two main types--oceanic and subhumid mesothermal. The oceanic type is characterized by cool, moist winters and cool summers with frequent sea breezes and early morning fog. The subhumid mesothermal type is characterized by cool, moist winters and hot dry summers. The boundary between the two types runs roughly in a southeast-northwest direction from the Calaveras Dam to Dublin. Differences in annual rainfall are associated with differences in relief and vary widely over short distances. For example, annual rainfall ranges from 8 inches in the northeastern corner of the Area to 25 inches at a point in the uplands 15 miles farther south.

In the sections of low rainfall, many of the soils are calcareous and alkaline in reaction. In the sections of high rainfall, the soils are slightly acid to strongly acid. Soils formed under the oceanic climate are darker in most places and contain more organic matter than soils formed in similar material under the subhumid mesothermal climate. Also, soils that developed under low rainfall have accumulated carbonates in the upper portions, whereas the soils that developed under high rainfall have been leached of carbonates.

Living organisms.--The vegetation of the Area was the most important part of the complex of living organisms that affected soil development. The activities of animals were of minor importance. Earthworms, insects, and bacteria were most active in soils containing a large amount of organic matter. In such soils they break down plant and animal remains to humus.

The influence of native vegetation was greatest in the dark Clear Lake soils in the northern part of the Livermore Valley and in the basin areas. In the uplands this vegetation consisted of thick stands of perennial grasses, such as Needlegrass, and of scattered Oak; in the basin areas it consisted of perennial grasses, sedges, and willows. The Linne soils also exemplify the influence of native vegetation. They developed under thick stands of perennial grasses and scattered Oak. These soils are dark gray and contain a relatively large amount of organic matter. In contrast, the Gaviota soils developed under a sparse stand of grasses, Rabbitbrush, and California Sage and contain a small amount of organic matter. The Vallecitos soils have accumulated even a smaller amount of organic matter under a combined woodland-grassland type of vegetation. The percentage

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[1]Soil Survey, Alameda Area, 1966, pp. 62-63.

of woodland varied, but it consisted primarily of Blue Oak, California Live Oak, Black Oak, Laurel, California Buckeye, and other woody plants. Some scattered Digger Pine and Coulter Pine were on higher elevations and on the sheltered north-facing slopes of these soils. The understory consisted of California Fescue, Needlegrass, Blue Wildrye, and Millicgrass. This kind of vegetation did not favor the accumulation of large amounts of organic matter.

The vegetation in the brush-covered areas consisted of Chamise, Manzanita, Ceanothus, Rabbitbrush, California Sage, and a sparse stand of grasses. Little organic matter has accumulated in the soils and land types in these areas.

Farming in the area has affected and will affect the direction and rate of development of the soils. The soil-forming processes changed most by man's activities are the accumulation of organic matter and the leaching of soluble salts. The rate of accumulation of organic matter has been reduced, and in some soils, the organic matter has been depleted. Cultivation and grazing have almost eliminated the native perennial grasses, and annual grasses, forbs, and weeds have been introduced by settlers. The forage produced is removed continuously by grazing and by burning residue from dry-farmed grain. Artificial drainage of the basin areas has reduced the amount of organic matter in the soils by improving aeration and thus increasing the oxidation of the organic matter. In the well-drained soils in the valleys, the amount of organic matter may have been increased by the continual use of irrigated pasture. Even though the forage is removed, the root system is extensive and tends to increase the amount of organic matter in the soil. Also, soluble salts and some of the carbonates are leached from these soils by irrigation water and through improved drainage.

Parent material.--The parent material of soils in the uplands consists of sedimentary and metasedimentary rocks of different composition and different geologic ages, intruded in some places by basic and ultrabasic igneous rocks. The sediminatary and metasedimentary rocks contain folds and faults in a very complex system. The sharp differences in the parent rocks tend to produce distinctive differences in soils.

In areas where the parent material consisted of the hard, metasedimentary rocks, the soils are shallow, have a low content of organic matter, and contain gravel or chert fragments that weather slowly. The Vallecitos soils are an example.

In areas where the parent material was interbedded sedimentary rock, the minerals weather easily because calcium carbonate is the principal cementing agent. In these areas the soils are usually deep, arefine textured, and have a calcareous subsoil. The Diablo soils are typical of this group.

In areas where serpentine, the predominant intrusive rock, was the parent material, the Henneke soils developed. They are reddish brown throughout, are shallow, and have low fertility.

The high terraces south of the Livermore Valley consists of poorly sorted gravel, sand, and clay that were deposited by fresh water. The deposits have a smooth surface that has a gentle incline of 10 to 30 degrees toward the valley. The Positas soils, which are low in fertility and have distinct B horizons, occur in this area.

The parent material of soils in the valleys consists predominantly of recent alluvium. In the southern part of Livermore Valley, the alluvium is typically and medium textured and contains variable amounts of gravel. The gravel is predominantly quartz and is strongly resistant to weathering. The Livermore soils that developed in this allumvium have faint horizons. In the northern part of the Livermore Valley and in the Amador Valley, the soils developed from fine-textured alluvium. The streams are small, and they flow from areas that have fine-textured soils.

Relief.--The Alameda Areas consists primarily of gently sloping to very steep uplands of the Mt. Diablo Range and of intermountain valleys. The northeastern corner of the Area is in the San Joaquin Valley. The slope and the size of the streams largely determine the texture of the soils in the valley. In areas adjacent to the larger streams, coarse-textured and gravelly soils, such as the Livermore and Pleasanton, have developed. The Pescadero and Solano soils formed on low terraces along the basins and basin rims. They have hogwallowed microrelief and an accumulation of salts and alkali. Soils, such as Gaviota, formed on the very steep slopes. They are shallow, and their horizons are faint. The Los Osos and Diablo soils occur in other upland areas and have characteristic landslide and seep areas formed at times when the soils were saturated.

Time.--The soils of the Alameda Area range from young to very old. The Yolo and Sycamore soils are adjacent to the larger streams. They are young and show little horizon differentiation. These soils receive new sediments from floods that occur at frequent intervals. On the terraces and alluvial fans, the soils, such as Positas, are older. Their suface layer is leached of bases, and the B2t horizons have had a distinct increase in the content of clay. The soils in the uplands, such as the Vallecitos, also reflect greater age by their distinct horizon differentiation.

Major Processes of Soil Formation[1]

Several processes take place in the formation of soil horizons. The differentiation of horizons in most soils is the result of two or more of the following processes: (1) Accumulation of organic matter; (2) leaching of carbonates and soluble salts; (3) translocation of silicate clay materials; (4) reduction and transfer of iron; (5) accumulation of soluble salts and alkali.

Organic matter has accumulated in the A horizon of all soils in the Alameda Area. Most of the organic matter is in the form of humus. The quantity is small in some soils but is fairly large in others. In such soils as Livermore very gravelly coarse sandly loam, the faint A horizon has a small amount of organic matter. In such soils as Clear Lake clay, the thick A horizon contains a fairly large amount of organic matter.

[1]Soil Survey, Alameda Area, 1966, pp. 62-63.

Leaching of carbonates and salts has occurred in most of the soils in the Area. In some soils, the carbonates have been leached out of the solum; in other soils, the carbonates and salts have been leached only from the A horizon. Leaching has had little effect in the removal of carbonates from soils that are strongly calcareous throughout, and the calcium content has kept the clays flocculated.

Translocation of silicate clay minerals has occurred in some soils in the Area. The clay films on ped faces and in root channels, as well as colloidal bridges between the sand grains, indicate the movement of silicate clay minerals from the A horizon. These soils have B horizons that range from faint to distinct.

Reduction and transfer of iron has occurred in all of the poorly drained and imperfectly drained soils. This process, called gleying, has been important in horizon differentiation in the poorly drained Clear Lake clay soils. The gray colors in the deeper horizons of the wet soils indicate a reduction of iron oxide. The reduction is commonly accompanied by the transfer of iron. In some of the well-drained soils, iron has been transferred from the A horizon to the B and C horizons where it has been deposited, has been oxidized, and has given these horizons a reddish-brown color. In other soils, iron has been segragated within the deeper horizons and occurs as yellowish-red or reddish-brown mottles. These soils were formed under moderately good drainage. Drainage of soils in valleys and basins has been improved either by stream cutting, by artificial drainage, or by pumping water for irrigation or domestic use.

Soluble salts accumulate in some soils or on the suface when water evaporates. Thus, salty soils commonly occur in low areas, and many have a periodically high or permanently high water table. A high water table or a perched water table exists naturally above an underlying, impervious stratum.

May different kinds of salt occur in saline soils. The normally neutral, or nearly neutral, salts, such as the chlorides and sulfates of sodium, calcium, and magnesium, do not make the soil strongly alkaline; but an excessive amount of exchangeable sodium may cause a strongly alkaline reaction.

The exchangeable cations in a soil greatly influence its properties. Calcium clays are mildly alkaline to moderately alkaline and are not easily dispersed. Conversely, sodium clays are strongly alkaline to very strongly alkaline and are more easily dispersed. If a high concentration of salt is maintained in the soil, the colloids are flocculated; but if drainage improves and excess salts are removed, the sodium clays become strongly alkaline or very strongly alkaline and are easily dispersed in water.

As drainage in soils improves, the excessive amounts of salts are leached. The sodium clays, which are easily dispersed, are puddled or run together. Some of the colloids also move downward from the surface layer and accumulate in the layer beneath. After a long period, most of the fine material has accumulated in the B horizon, and mostly silt and sand are left in the A horizon. Weathering of minerals in the B horizon also contributes to its high content of clay.

If leaching continues for a long time, the A horizon of the soil finally becomes acid. The B horizon becomes very slightly acid to strongly alkaline and has well-developed columnar structure. This horizon underlies a distinct leached A2 horizon. The soil generally has hogwallowed relief. Apparently, the horizon is eroded, and the B horizon is exposed in many places. Locally, the shallow depressions are called slickspots.

DESCRIPTION OF THE SOILS[1]

There are several land types and twenty-five different soil areas on the General Soil Map for Alameda County. The Miscellaneous land types are named primarily in terms of land form or in terms of material. The soils areas are named by the major series that occur within each area. A soil series is a group of soils that has about the same kind of profile, or sequence of layers. Except for different texture in the surface layer, all the members of one soil series have major horizons of layers that are similar in thickness, arrangement, and other important characteristics. Some soil areas on the General Soil Map have the same soil series for which they are named, but differ by properties or qualities of major importance to use and management. These are separated (or phased) by indicating differences such as slope, erosion, coarse fragment, drainage, salt and alkali or surface texture. In Alameda County, some of the soil series have been separated for major differences in slope and drainage.

The soil series names in the area adjacent to the San Francisco Bay are tentative and may be changed in the future. Any changes in names will not affect the usefulness of the map because the soil properties and qualities do not change and the names are only a means of identifying the mapping units.

The twenty-eight mapping units for Alameda County are organized into eight groups based on soil characteristics and qualities, and one group including the three miscellaneous types. The nine major groups and mapping units within each group are described below:

Group I - Areas dominated by very deep, well drained, loamy soils on level to nearly level alluvial fans and low terraces.
- Yolo-Sorrento-Sycamore (drained) association
- Rincon-Zamora association
- Pleasanton-Livermore association
- Livermore association

Group 2 - Areas dominated by deep, somewhat poorly drained, loamy soils of the low flood-plains and coastal plains.
- Sycamore association
- Baywood association, wet variant

Group 3 - Areas dominated by very deep, slowly permeable soils on nearly level to gently rolling alluvial fans.
- Cropley-Rincon association
- Cropley-Rincon association, 2 to 9 percent slopes.

Group 4 - Areas dominated by gray or dark gray, clayey soils of the basin rims and basins.
- Clear Lake-Sunnyvale association, drained
- Clear Lake association
- Sunnyvale-Castro association

[1] Generalized Soil Map, U. S. Department of Agriculture, Soil Conservation Service, and ABAG (1966).

Group 5 - Saline-Alkaline soils of the basin rims with moderately slow or slowly permeable subsoils.
Solano-Pescadero association, eroded

Group 6 - Undulating to very steep, shallow to moderately deep, gravelly and loamy soils developed to high terraces.
Positas association, 2 to 15 percent slopes, eroded
Positas-Perkins association, 15 to 30 percent slopes, eroded
Positas-Perkins association, 30 to 60 percent slopes, eroded

Group 7 - Areas dominated by clayey upland soils developed on soft shales and fine-grained sandstone.
Diablo-Altamont association, 9 to 30 percent slopes, eroded
Diablo-Altamont association, 30 to 50 percent slopes, eroded
Altamont-San Benito association, 9 to 30 percent slopes, eroded
Linne-Altamont association, 9 to 30 percent slopes, eroded

Group 8 - Areas dominated by loamy, upland soils developed on sedimentary rock with some intrusions of oasic and ultrabasic igneous rock.
Los Gatos-Gaviota association, 30 to 70 percent slopes, eroded
Los Osos-Millsholm association, 9 to 30 percent slopes
Los Osos-Millsholm association, 30 to 70 percent slopes, eroded
Climara-Los Osos association, 30 to 50 percent slopes, eroded
Henneke association, 50 to 75 percent slopes, severely eroded
Vellecitos-Gaviota association, 30 to 70 percent slopes, eroded

Group 9 - Other soils.
Tidal Flats
Made Soils, over bay mud
Gravel pits

Agricultural Resources

The resource value of agricultural lands is derived primarily from the crops that are grown on them. The agricultural lands of Alameda County not only benefit from the climate, soils and water supply, but also the close proximity of both a large consumer area and a deep water port. Non-agricultural benefits of our agricultural resources include water management, recreation and visual/aesthetic enjoyment. A secondary benefit is derived from having the land in an open condition.

Many farmers and ranchers in Alameda County provide multiple opportunities for the production and maintenance of other resources through their agricultural operations besides those which are of direct economic value to his agricultural or livestock operation. Such actions are complimentary to the balance of renewable resources as well as the production of a marketable commodity and the conservation of non-renewable resources. Many farmers and ranchers permit more than one type of use of their land which doesn't interfere with their operations. Many of their regular annual activities (such as brush clearing, and controlled burning) improve habitat values for livestock and crops, as well as game and non-game species. Such a multiplicity of complimentary uses is applied to federal lands under guidelines developed by the Forest Service and the Bureau of Land Management and also may apply to land in private ownership in Alameda County.

Following mapping by the Soil Conservation Service of the soil types in Alameda County, several methods of rating the soils as to their potential for certain kinds of agricultural crop production were developed; two of the most commonly used national systems are the land capability classification groups and the "prime lands" systems. The capability classfication groups the twenty eight soil types in Alameda County into seventeen capability units which each show unique characteristics with respect to agricultural production. The simplified "prime lands" system designates lands as "prime agricultural," "prime rangeland" or "unique agricultural" based upon the agricultural potential of the land. These methods of rating agricultural lands allow farmers as well as government officials to identify, manage and protect the county's agricultural resources.

Land Capability Classification

The capability classification is an interpretative grouping made primarily for agricultural purposes. The classification begins with individual soils and groups them into different categories primarily on their ability to produce common cultivated crops and pasture plants without soil deterioration over a long period of time.

The land capability classification provides three different levels of information. These are as follows:

1. Land Capability Classes - The broadest category placing all soils in eight capability classes. These are arranged from I to VIII with limitations in soil use and risks of soil damage increasing from I to VIII.

2. Land Capability Subclass - This category is a subdivision of the capability class to show the kind of limitation or hazard. Four subclasses are used: e (erosion), w (wetness), s (soil), and c (climate). These subclasses are subdivided by adding an Arbaic numeral which is designated as a unit. This numeral is used to show a secondary major limitation or to supplement the major limitation and is defined in terms of a significant soil property.

3. Land Capability Unit - This unit is a group of soils that are similar in use and management and provides the most specific information in Land Capability Classification. The capability unit is symbolized by a combination of the class, subclass and unit.

In assigning soils to capability groupings, certain basic assumptions must be made. These assumptions are required to group souls consistently and to use the groupings properly. The assumptions for classifying the soils of Alameda County are:

1. Classification is based on the effects of combinations of climate and permanent soils characteristics on risks of soil damage, limitations in use, productive capacity, and soil management requirements.

2. A moderately high level of management is assumed - one that is practical and within the ability of a majority of the farmers and ranchers.

3. Soils considered feasible for improvement by drainage, irrigation, removing salts and/or exchangeable sodium, or by protecting from overflow are classified according to their continuing limitations in use, or the risk of soil damage, or both, after the improvements have been installed.

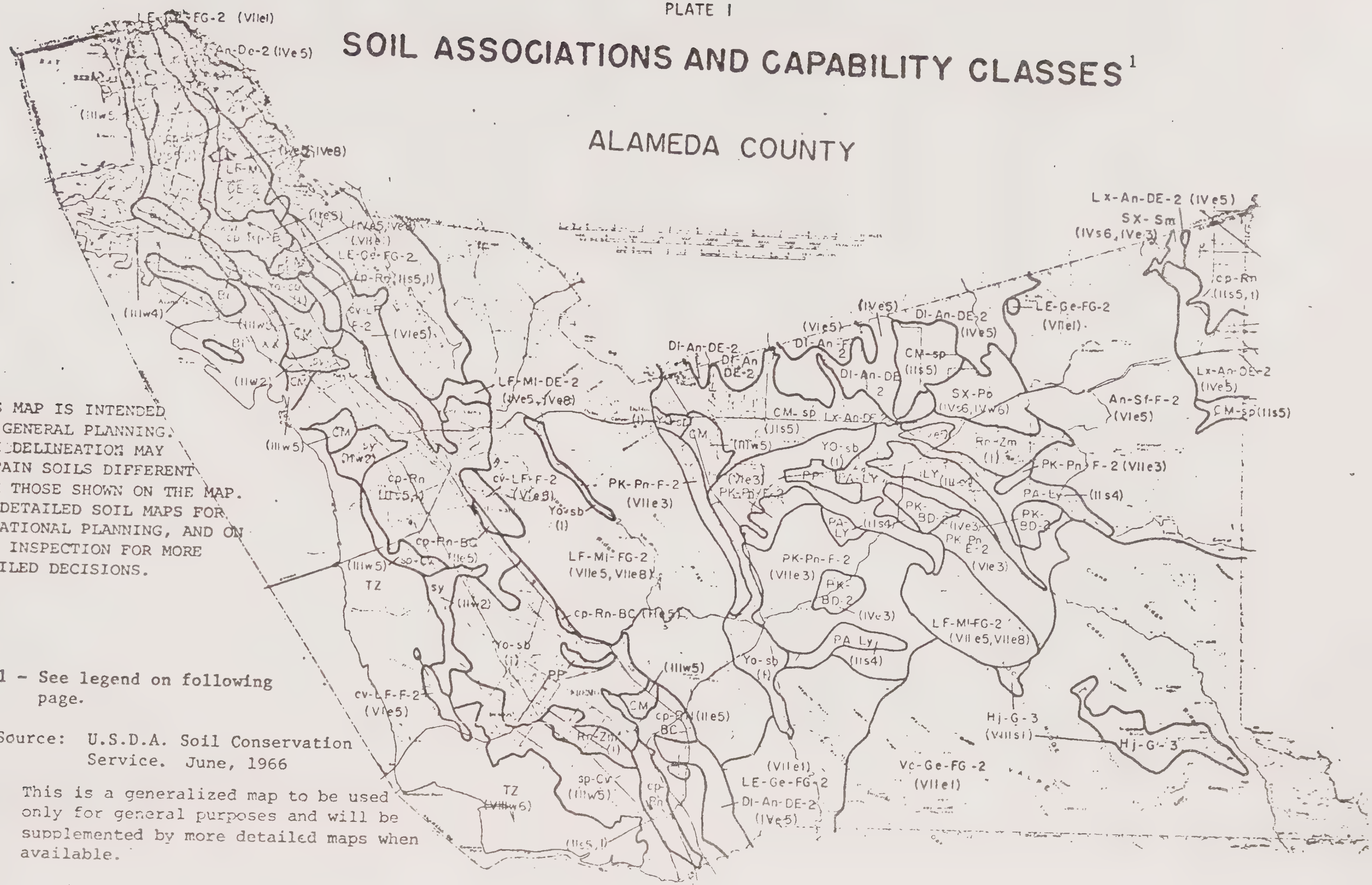
4. The capability classification of the soils in an area may be changed when major reclamation projects are installed.

5. Capability groupings may be changed as new information about the soils becomes available.

PLATE I

SOIL ASSOCIATIONS AND CAPABILITY CLASSES[1]

ALAMEDA COUNTY



THIS MAP IS INTENDED FOR GENERAL PLANNING. EACH DELINEATION MAY CONTAIN SOILS DIFFERENT FROM THOSE SHOWN ON THE MAP. USE DETAILED SOIL MAPS FOR OPERATIONAL PLANNING, AND ON SITE INSPECTION FOR MORE DETAILED DECISIONS.

1 - See legend on following page.

Source: U.S.D.A. Soil Conservation Service. June, 1966

NOTE: This is a generalized map to be used only for general purposes and will be supplemented by more detailed maps when available.

A land capability classification symbol is composed of three symbols that indicate the class, subclass and unit of the capability unit.

Classes

Land Suited for Cultivation and Other Uses

Class I - Soils in Class I have a few limitations that restrict their use.

Class II - Soils in Class II have some limitations that reduce the choice of plants or require moderate conservation practices.

Class III - Soils in Class III have severe limitations that reduce the choice of plants or require special conservation practices or both.

Class IV - Soils in Class IV have very severe limitations that restrict the choice of plants, require very careful management, or both.

Land Generally Not Suited for Cultivation

Class V - Soils in Class V have little or no erosion hazard but have other limitations that are impractical to remove.

Class VI - Soils in Class VI have severe limitations that make them generally unsuited for cultivation.

Class VII - Soils in Class VII have very severe limitations that make them unsuited for cultivation.

Class VIII - Soils and land forma in Class VIII have limitations that preclude their use for commercial plant production and restrict their use to recreation for wildlife, water supply, or aesthetic purposes.

Subclasses

(The Major Problem)

e - erosion
w - wetness
s - soil limitation
c - climatic limitation

Units

(The Secondary Problem)

IIIe5
- 0 - Coarse underlying material
- 1 - Erosion hazard
- 2 - Drainage or overflow
- 3 - Slowly permeable subsoils
- 4 - Coarse textures
- 5 - Fine textures
- 6 - Saltinity or alkali
- 7 - Stony or rocky
- 8 - Cemented layers or bedrock
- 9 - Low fertility or toxic elements
- 10 - Organic soils

Following are the capability units found in Alameda County. Plate I also shows the mapping of these units.

Capability Unit I	Very deep, well drained moderately coarse to moderately fine textured, nearly level soils
Capability Unit IIs4	Very deep, well drained, coarse textured or gravelly soils, nearly level.
Capability Unit IIs5	Deep and very deep, well to moderately well drained, fine textured solid on nearly level slopes.
Capability Unit IIe5	Deep and very deep, well drained, moderately fine textured soils on gentle to moderate slopes.
Capability Unit IIw2	Very deep, imperfectly drained, moderately coarse to moderately fine textured soils with rapid to moderately slow permeability.
Capability Unit IIIs5	Very deep, poorly to imperfectly drained, slowly permeable fine and very fine textured basin soils.
Capability Unit IIIs4	Very deep, somewhat excessively drained very coarse textured soils on nearly level to moderate slopes.
Capability Unit IVe1	Medium textured, shallow soils over interbedded sedimentary rock on gently to moderately steep slopes.
Capability Unit IVe3	Shallow to moderately deep, medium textured soils with a very slowly permeable claypan or other tight subsoils on strong slopes.
Capability Unit IVe5	Moderately deep to deep, fine textured, well drained soils on moderately steep slopes.
Capability Unit IVw6	Saline-alkali soils occuring on the basin rims and basins.
Capability Unit IVe3	Moderately coarse to medium textured soils with slowly permeable subsoils and claypans on moderately steep slopes.
Capability Unit VIIe1	Shallow to moderately deep medium and moderately fine textured soils on steep to very steep slopes.
Capability Unit VIIe3	Shallow to moderately deep, moderately coarse to medium textured soils with slowly or very slowly permeable subsoils on steep to very steep slopes.
Capability Unit VIIIs1	Shallow, somewhat excessively drained soils on very steep upland.
Capability Unit VIIIw6	Tidal flats and very poorly drained soils of the basins.

Identifying Prime Agricultural Lands

To preserve the productive capacity and aesthetic value of agricultural land resources a system of identifying prime agricultural lands has been established as a part of a nationwide program of the Soil Conservation Service. The best land for producing food, feed, fiber, forage and oil-seed crops is mapped as Prime Agriculture, Prime Range or Unique Agriculture. The two "Prime" designations are based on the types of soils present as mapped in the Alameda County Soil Survey and the "Unique" designation is based on the use of the land as well. The specific criteria for grouping soils as Prime, Unique and other are provided by the Soil Conservation Service. (See Plate 2, page 14a.)

Prime Agricultural Land

Prime farmland is land best suited for producing food, feed, forage, fiber, and oilseed crops, and also available for these uses (the land could be cropland, pastureland, rangeland, forest land, or other land but not urban builtup land or water). It has the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops economically when treated and managed, including water management, according to modern farming methods. The criteria set up for Alameda County is the same as that suggested by USDA-Soil Conservation Service.

1. Adequate moisture supply during the growing season. This can be either rainfall or by irrigation.

2. The soils have a pH between 4.5 and 8.4 in all horizons within a depth of 40" or in the root zone if the root zone is less than 40". This range of pH is favorable for growing a wide variety of crops without adding large amounts of amendments.

3. No water table or a water table that is maintained at a sufficient depth so as not to adversely affect a crop.

4. The soils can be managed so that, in all horizons within a depth of 40 inches or in the root zone if the root zone is less than 40", during part of each year the conductivity of saturation extract is less than 4mmhos/cm and the exchangeable sodium percentage (ESP) is less than 15.

5. The soils are not flooded frequently during the growing season (less often than once in 2 years).

6. The soil does not have a serious erosion hazard.

7. The soil has a permeability of at least 0.05 inches per hour in the upper 20 inches.

8. Less than 10 percent of the surface layer in these soils consists of rock fragments coarser than 3 inches. These soils present no particular difficulty in cultivating.

Soil series in the Alameda Area (County) soil surveys that fit within this criteria are listed on Table 1.

Prime Range Land

Approximately one-half of the acreage of Alameda County is used for livestock production. The gross income from livestock in 1974 was about $4,700,000. Since livestock production is important to Alameda County, prime rangeland should be recognized and identified. The criteria used for prime range land* are:

1. Land capable of producing enough natural forage to feed one animal unit per acre for one month under normal conditions. The quantity of forage produced should be sufficient to feed the animal unit and provide enough cover the protect the soil resource year after year.

2. Land of less than 45 percent slopes.

Soils that fit this criteria in Alameda County are listed on Table 1.

Certain of these prime range soils also have a high value on the production of dryland grain and grain hay. These are:

Soil Series	Grain (100 lbs/acre)	Grain Hay (Tons)
AaC	25+	2+
DbC	25+	2+
DvC	25+	2+
LaC	25+	2+
LtD	25+	2+

Unique Agricultural Land

Unique farmland is land other than prime farmland that is used for the production of specific high value food and fiber crops. It has the special combination of soil quality, location, growing season, and moisture supply needed to produce sustained high quality and/or high yields of a specific crop when treated and managed according to modern farming methods.

Unique farmland has the following characteristics:

1. It is used for a specific high value crop.

2. It has an adequate moisture supply for the specific crop.

3. It combines favorable factors of soil quality, growing season, temperature, humidity, air drainage, elevation, aspect, or other conditions that favor the growth of a specific crop.

(*Almost all of the hills and mountains in Alameda County are used for livestock production. Some of the areas are very steep or rocky or shallow soils, or any combination of limiting factors which do not make them prime range land -- but because of these limiting factors, their highest use is livestock and production.)

TABLE 1 - PRIME AGRICULTURAL SOILS OF ALAMEDA COUNTY [1]

Soils Series	Water Dry	Water Irrig.	pH	Water Table	Salinity MMHOS/CM	Flood Hazard	Erosion Hazard	Permeability in./hr.	Surface Rock	Irrigated[2] Crops	Dryland Crops	Capa-bility Class	Storie Index
BaA	X	X	6.8-8.2	>6.0'	NA	NA	Slight	.6-2.0	No	Orchard, row, & Field crops, pasture	Grain and grain hay	I	95
CdA	X	X	6.5-8.2	>6.0'	NA	NA	Slight	.05-.2	No	Pasture, row & Field Crops	Grain and grain hay	IIa5	49
CdB	X	X	6.5-8.2	>6.0'	NA	NA	Slight	.05-.2	No	Pasture, row & Field crops	Grain and grain hay	IIe5	46
CjA	X	X	7.0-8.2	>6.0'	NA	NA	Slight	.8-2.5	No	Orchard, Vineyard, rose, row and field crops, pasture	Grain and grain hay	I	95
DaA	X	X	6.1-7.4	>6.0'	NA	NA	Slight	.05-.2	NA	Pasture, row & Field crops, roses	Grain and grain hay	IIs3	86
DaB	X	X	6.1-7.4	>6.0'	NA	NA	Slight	.05-.2	NA	Pasture, row & Field crops, roses	Grain and grain hay	IIe3	81
Lg	X	X	6.1-7.4	>6.0'	NA	NA	Slight	2.5-10.0	Some	Vineyard, orchard, pasture	Grain	IIs4	63
OmA	X	X	6.6-8.4	>6.0'	NA	NA	Slight	.05-.2	NA	Row and Field crops, pasture	Grain and grain hay	IIs5	50
PgA	X	X	6.1-7.8	>6.0'	NA	NA	Slight	.2-2.5	Some	Vineyard, orchard, roses, row & field crops, pasture	Grain and grain hay	IIs3	68
PgB	X	X	6.1-7.8	>6.0'	NA	NA	Slight-moderate	.2-2.5	Some	Vineyard, orchard, roses, row and field crops, pasture	Grain and grain hay	IIIe3	58
Rc	X	X	7.0-7.5	>6.0'	NA	NA	Slight	.05-.8	NA	Row & Field crops, orchard, roses	Grain and grain hay	IIs3	80
RdA	X	X	7.0-7.5	>6.0'	NA	NA	Slight	.05-.8	NA	Row & Field crops, orchard, roses	Grain and grain hay	IIs3	68
RdB	X	X	7.0-7.5	>6.0'	NA	NA	Slight-moderate	.05-.8	NA	Row & Field crops, orchard, roses	Grain and grain hay	IIIs5	65

TABLE 1 (cont.)

Sl	X	X	7.9-8.2	<6.0'	NA	NA	Slight	.2-2.5	NA	Row & Field crops pasture	Grain and grain hay	IIw2	65
Sm	X	X	7.9-8.2	<6.0'	NA	NA	Slight	.2-2.5	NA	Row & Field crops pasture	Grain and grain hay	IIw3	61
Sn	X	X	7.9-8.2	>6.0'	NA	NA	Slight	.2-2.5	NA	Row & Field crops pasture	Grain and grain hay	I	81
So	X	X	7.9-8.2	>6.0'	NA	NA	Slight	.8-2.5	NA	Row & Field crops, vineyard, roses, pasture, orchard	Grain and grain hay	I	100
Sy	X	X	7.9-8.2	>6.0'	NA	NA	Slight	.05-2.5	NA	Row & Field crops, pasture, roses	Grain and grain hay	IIs3	72
SsA	X	X	8.0-8.2	>6.0'	NA	NA	Slight	.2-.8	NA	Row & Field crops, pasture	Grain and grain hay	I	95
YmA	X	X	7.4-8.2	>6.0'	NA	NA	Slight	.8-2.5	NA	Row & Field crops, pasture, roses, orchard, vineyard	Grain and grain hay	I	100
YmB	X	X	7.4-8.2	>6.0'	NA	NA	Slight-moderate	.8-2.5	NA	"	"	IIe1	90
Yo	X	X	7.4-7.8	>6.0'	NA	NA	Slight	.8-10.7	NA	"	"	IIIs0	80
Yr	X	X	7.4-8.2	>6.0'	NA	NA	Slight	.8-2.5	NA	"	"	IIs4	75
Ys	X	X	7.4-8.2	>6.0'	NA	NA	Slight	.8-2.5	NA	"	"	I	95
Za	X	X	7.4-8.2	>6.0'	NA	NA	Slight	.2-.8	NA	"	"	I	95
Zc	X	X	7.4-8.2	>6.0'	NA	NA	Slight	.2-.8	NA	"	"	I	86

[1] Information taken from Soil Survey, Alameda Area, Ca. USDA-SCS, published 1966 and the 1975 Soil Survey of Western Alameda Co. (not published).

[2] Row crops include: cabbage, cauliflower, lettuce, romaine, miscellaneous vegetables.
Field crops include: corn, tomatoes, cucumbers, irrigated wheat, oats, milo, sugar beets, alfalfa.
Orchard crops include: walnuts, cherry, apricot, peach, miscellaneous deciduous fruits.

TABLE 2 - PRIME RANGE SOILS (1)

Soil Series	Range Site	Normal Year's Forage Production	AUMs (2) Per Acre
AaC	Clayey	3000 lbs/acre	2.5
AaD	Clayey	3000	2.5
AmE2	Clayey Hills	2700	2.1
ArD	Clayey Hills	2700	2.1
AzD	Clayey	3000	2.5
AzE2	Clayey Hills	2700	2.1
Cc	Clayey	3000	2.5
DbC	Clayey	3000	2.5
DbD	Clayey	3000	2.5
DbE2	Clayey Hills	2700	2.1
DvC	Clayey	3000	2.5
DvD2	Clayey	3000	2.5
LaC	Clayey	3000	2.5
LaD	Clayey	3000	2.5
LaE2	Clayey Hills	2700	2.1
LpF2	Loamy Uplands	2300	1.6
LsC	Loamy	2500	1.9
LtD	Loamy	2500	1.9
LtE2	Loamy Uplands	2300	1.6
LuD	Loamy	2500	1.9
LuE2	Loamy Uplands	2300	1.6
SdD2	Loamy	2500	1.9
SdE2	Loamy	2300	1.6

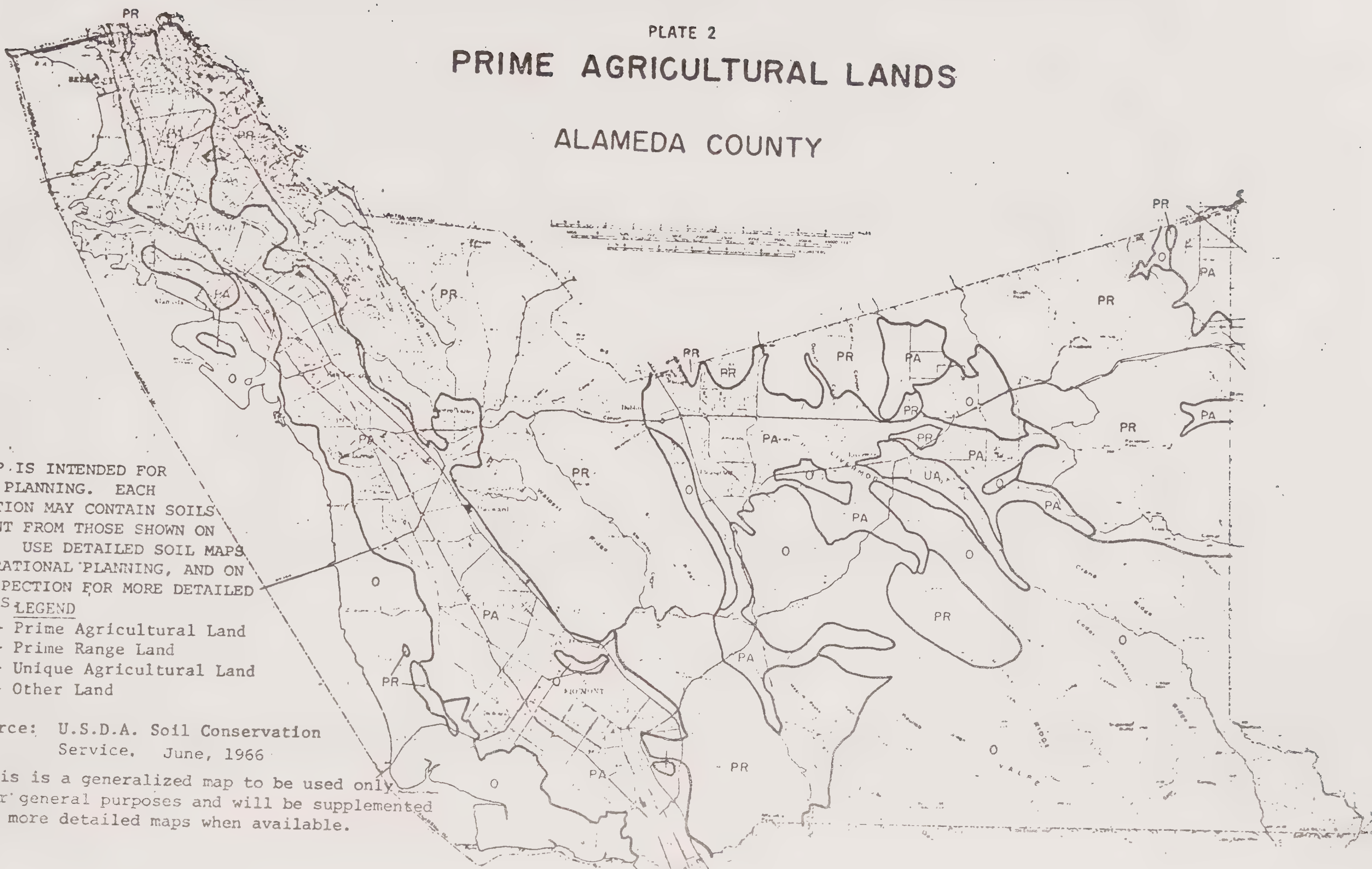
(1) Taken from Alameda Area Soil Survey (19[illegible]), pages 42, 43, and 19

(2) $\text{AUM} = \frac{\text{Forage Production (lb/ac)} - \text{1000 lb/ac (Protection of soil from erosion)}}{\text{800 lb/ac (normal consumption of one Animal Unit in one month)}}$

PLATE 2

PRIME AGRICULTURAL LANDS

ALAMEDA COUNTY



THIS MAP IS INTENDED FOR GENERAL PLANNING. EACH DELINEATION MAY CONTAIN SOILS DIFFERENT FROM THOSE SHOWN ON THE MAP. USE DETAILED SOIL MAPS FOR OPERATIONAL PLANNING, AND ON SITE INSPECTION FOR MORE DETAILED DECISIONS.

LEGEND

PA - Prime Agricultural Land
PR - Prime Range Land
UA - Unique Agricultural Land
O - Other Land

Source: U.S.D.A. Soil Conservation Service. June, 1966

NOTE: This is a generalized map to be used only for general purposes and will be supplemented by more detailed maps when available.

Alameda County has crops and areas that fit into these criteria. Livermore very gravelly coarse sandy loam (Lm - IVs4) soil is used for high quality grape production. There are areas along the bay where the soils are classed as IIIw5 - Clear Lake clay, IIIw4 - Laugenour loam, and IVw6 - Willows clay, but due to intensive management and the favorable climate are able to produce two and three crops of high value vegetables per year (cauliflower, cabbage, lettuce, romaine, miscellaneous vegetables). Flowers and nursery stock are another high value crop that does not require prime agricultural soils, but a high degree of management and ideal growing climate.

These unique crops of Alameda County are usually high in cash value and also lend an air of identification. Locating and mapping of these area of Alameda County will need to be done on an individual survey basis due to lack of information on specific types of soil and land involved.

Plate 2 shows the extent of prime agricultural, prime range and unique agricultural lands in Alameda County. Notice that with the minor exception of the "unique" lands, these categories relate only to the soil types, not to the use of the land and consequently cover much developed land. Preliminary estimates of the acres of prime and unique lands in Alameda County are given below:

Prime agricultural lands	130,969 acres
Prime rangelands	185,344 acres
Unique croplands	3,968 acres
	320,281 acres (68% or total)
Other	148,199 acres
Total County acreage	468,860 acres
Lands in Williamson Act Preserves	180,487.71 acres

History of Agriculture in Alameda County

The history of agriculture in the County dates back to the middle of the last century when early settlers discovered the potential of the rich soil and mild climate along the bay floodplain. In fact, it was the agricultural resources of the area which gave the Eden Township its name. Fruit culture and vegetable production soon gained prominence in both the Eden and Washington Townships. Wheat continued to be the mainstay in the Murray Township until it was discovered that the climate and valley soils were well suited to the production of quality wine grapes.

The Livermore Valley has never been a large producer of wines, but it has long had recognition as an area for the production of high quality white wines.

The importance of fresh fruit and vegetable production on the floodplain of the East Bay grew as the San Francisco area increased in population. This urban area provided an ideal market for the high yields of the fertile Alameda County plains.

In recent times the relative importance of various agricultural commodities has changed. Urbanization of the western part of the County has eliminated most of the fruit and nut orchards. The Fremont and Union City areas are more specialized, concentrating on cole crops and lettuce.

Trends in Agriculture

An examination of the County Agricultural Commissioners' reports for the period 1950 through 1968 gives an indication of trends in agriculture in the County.

The bulk of the income from agricultural commodities produced in the County is from irrigated crops and from livestock. About 4 percent of a total agricultural income of 36 million dollars in 1968 came from non-irrigated or dry-farmed crops.

Irrigated crop acreage as reported by the Agricultural Commissioner, has gone from about 28,000 acres in 1950 to 19,500 in 1968. There was a peak of over 33,000 acres irrigated in 1955. Since 1955 there has been a steady decrease averaging about 1,000 acres of irrigated cropland per year.

The largest decrease in acreage among irrigated crops between 1950 and 1968 was incurred by field crops, followed by fruit and nut crops, and then by row crops, which lost very little acreage. This would be expected when viewed from an economic point of view since field crops give a lower rate of return per acre than orchard and row crops.

Since 1968 some other trends have been manifest. The acres in field crops declined slightly from 1968 to around 1971 and then showed a slight increase through 1975. The acres in fruit and nut crops and especially row crops have decreased through 1975. Cut flowers, bedding plants, vegetables and other nursery products grown in green houses have shown little change from 1968 through 1975. The count of livestock and poultry in Alameda County has seriously declined particularly in 1973 when a major poultry grower moved. Production of the relatively minor apiary products has been erratic in the last eight years as it always is but has shown neither a growth nor a decline trend. There are approximately 3,000 people directly employed in Alameda County agriculture excluding the many thousands indirectly employed such as at the canneries.

Despite the downward trend in the number of acres in several types of agriculture, rising productivity and inflation have maintained the value of farm production in Alameda County at within 10% of the same point for the last eleven years. With acreage holding steady, the value of field crops has more than doubled between 1968 and 1975. While this value of vegetable crops slumped from 1968 to 1971, it has since remained relatively constant. Excluding the years 1973 and 1974, when unusually high per acre yields were obtained, the value of fruit and nut crops produced in Alameda County has remained rather constant. Nursery stock and products led by cut flowers, now the County's most valuable agricultural products, have grown steadily in the last decade. The value of poultry and livestock produced in Alameda County has remained relatively constant except for a very successful year in 1974 in spite of declining head counts.

Table 3 gives the value of various crop types produced in Alameda County between 1968 and 1975.

TABLE 3

VALUE OF AGRICULTURAL PRODUCTION BY TYPE OF CROP:
ALAMEDA COUNTY, 1968-1975, ($MILLION)

Crop	1968	1969	1970	1971	1972	1973	1974	1975
Field Crops	2.381	2.532	2.608	3.217	2.635	3.606	4.907	5.312
Vegetable Crops	9.078	6.145	7.452	5.525	5.130	5.503	5.280	5.954
Fruit and Nut Crops	1.760	1.749	1.191	1.716	1.907	3.102	2.213	1.567
Nursery Products	5.937	6.274	6.379	6.273	6.312	7.557	8.349	9.665
Cut Flowers	10.200	10.437	9.488	10.481	10.127	10.588	10.549	11.238
Livestock and Poultry	5.289	5.426	5.297	5.210	5.068	7.419	5.611	5.863
Livestock and Poultry Products	1.632	1.346	0.711	1.780	0.973	2.357	0.320	0.195
Apiary Products	0.019	0.038	0.018	0.022	0.031	0.055	0.046	0.048
Total	36.295	33.946	33.144	34.225	32.183	40.186	37.274	39.841

History of Urbanization in Alameda County

A look at the way in which urbanization has progressed in each of the Sounty County planning units gives an indication of the impact this urbanization has had on agriculture in the County. The Central Metropolitan Planning Unit is not considered because it developed before the decline of agriculture in the County.

Particular attention is given to irrigated lands, as opposed to dry farmed or grazing lands, because most of the urbanization has taken place on irrigable land.

The loss of agricultural lands began with the expansion of Hayward and San Leandro during World War II. The Eden Planning Unit has been an area dominated by orchard crops of apricots, prunes and cherries before their demise under urban pressures. The 1966 crop survey done by the State Department of Water Resources showed only 300 acres of irrigated cropland remaining in an area approximately equal to the south half of the Eden Planning Unit.

Most of the urban growth in the Washington Planning Unit has been since 1950 when it had a population of less than 20,000. The latest population estimate is 144,500 as of January 1, 1970. This growth in population resulted in a decrease of irrigated acreage from 18,000 acres in 1960 when the population was 60,926 to 8,300 acres in 1966 according to the State Department of Water and Resources report. The population in July 1966 was estimated to be 122,500.

This is a loss of almost 10,000 acres or irrigated lands in six years with an increase in population of about 61,500 over the same time period.

The Livermore-Amador Valley Planning Unit also shows a high recent growth pattern. It has increased from a population of about 16,000 in 1950 to 79,400 as of January 1, 1970. The State's report shows 6,400 acres as irrigated in 1960 when the population was 29,640, and the same irrigated acreage in 1966. The same report shows an increase in urban acreage of 2,800 acres, having increased from 7,400 in 1960 to 10,200 in 1966. Much of the development in the Livermore-Amador Valley occurred on non-irrigated lands and some lands not previously irrigated were brought into production between 1960 and 1966.

As was pointed out above, the total irrigated acreage for Alameda County over the thirteen year period from 1955 to 1968 has gone from 33,000 acres to about 20,000 acres. Most of this decrease is attributable to urbanization.

With the urbanization of County lands has come increased levels of air pollution. Whether or nor air pollution has had a deleterious effect on agriculture is the subject of some debate and is being studied further by scientists of both pollution control and agricultural backgrounds.

The Role of Agriculture in the Economy of the County

The importance of agriculture to the economy of the County might best be evaluated by a review of the number of jobs and the amount of money involved.

Data from the California State Department of Employment shows that there were 20,800 people employed either directly in agriculture or in food processing in Alameda County for the year 1968. Alameda County Planning Department projections to the year 1972 indicate employment of 21,400 in the same categories. These figures represent about 4.7% of total employment in the County for 1968 and an estimated 4.3% in 1972.

The economic impact of agriculture includes the manufacture and distribution of farm supplies, processing of food and other agricultural products and distribution of farm commodities. The combined aspects of agriculture is terms "agribusiness".

Agribusiness employs nearly 25% of all those employed in manufacturing in the County as there were 16,100 persons employed in Food and Kindred Products in addition to 4,700 employed directly by agriculture for a total of 20,800 out of a total manufacturing employment of 84,800 in 1968.

The Food and Kindred Products portion of agribusiness had a payroll of over 100 million dollars in 1963 compared to about 500 million for all manufacturing.

Alameda County owes a large share of its employment in food processing to its strategic location and port facilities. Many of the products grown in the Central Valley and shipped through Alameda County are processed here before shipment to markets throughout the world via the Port of Oakland.

The annual gross income of agricultural products in the County has not varied much since 1945, even with the decrease in agricultural lands. Gross income hit a peak in 1952 of over 38 million dollars and was between 31-33 million from 1961 to 1965. The 1968 figure was 36 million dollars. The true value of these figures is distorted to the extent that inflation has affected dollar values.

The reason for the apparent paradox--a decrease in agricultural land with no decrease in gross income--is explained by the fact that land use is intensified and yields are increased by use of new varieties and technological improvements as pressure for other land uses increases. Indicative of this trend is the fact that greenhouse and nursery stock production grossed 7.3 million dollars in 1950 and 16.1 million dollars in 1968. Population pressures affect ornamental horiculture less than any other agricultural enterprise because it requires very little land and has a very high rate of return per acre.

LOCATION OF MAJOR AGRICULTURAL ENTERPRISES

Greenhouse and Nursery Stock

Some of the greenhouse industry is interspersed with urban development in San Lorenzo, San Leandro and Hayward. Fremont and Union City also have an appreciable greenhouse industry. There are several factors working against the greenhouse industry. Among these are land prices age of producer, lack of modern equipment and smog. Smog has a serious effect on carnations and orchids.

Grapes

The production of wine grapes has continued in the County since the days of the missions and it looks as though they will remain for a long period of time. There were 500 acres planted near Sunol this year and 500 acres more are planned for next year.

Wines produced in Livermore Valley are widely known for their quality. Added to the value of the grapes and wine is the scenic beauty of the vineyards and the prestige value of producing some of the worlds finest wines.

Row Crops

About 75 percent of the Alameda County row crops mapped by the Department of Water Resources in 1966 were in the Fremont-Alvarado areas while the remainder was in the Livermore-Amador Valley. In addition to these areas, the portion of the County which touches the floor of the Central Valley is primarily used for row crops.

The Fremont-Alvarado area warrants special mention here as it is one of only four areas in the State in which head lettuce can be raised throughout the summer. All four areas, which have a coastal climate in combination with prime soils and adequate water, are presently under heavy pressure from forces of urbanization.

Hay and Grain

Dry farmed hay and grain acreage is holding steady as most of these crops are grown in the hill areas away from urban pressure.

Irrigated pasture and alfalfa are being converted to urban use or to more intensive agricultural uses. In both the Livermore and the Washington Planning Unit the acreage of pasture and alfalfa combined decreased about 30% between 1960 and 1966 according to the State Report.

Livestock Production

Over half of the total area of the County is presently in range land is shown as uncultivated agriculture on the General Plan. Since there is not likely to be much decrease in range land in the near future, the livestock industry, with the exception of dairying, is expected to remain stable.

Poultry Production

During World War II there was a large poultry industry centered in the Castro Valley-Hayward area on several thousand family farms; however, between 1950 and 1968 both egg and meat production in the County have been reduced to less than half the 1950 level having gone from 7.5 million to 3.6 million dollars gross income.

D. Vegetation and Wildlife Resources

1. Classification of Natural Communities - Shoreline Area

The western portion of Alameda County consists of an urban corridor running between Berkeley and Fremont with a narrow fringe of marshlands along the Bay and considerable open space in the East Bay Hills. Of the 206,740 acres in the Central Metropolitan, Eden, and Washington Planning Units, approximately 80,810 acres would fall into the land use categories of uncultivated/undeveloped or major parks and recreation. Conditions in the East Bay Hills are similar to that found in the lowland hills in the Livermore Valley. The plant-animal-human interference patterns will be discussed. Numerous Environmental Impact Reports prepared by cities and the County on projects located in the Hills describe localized environmental settings. Also of great utility

and importance is the report done for the City of Hayward, the Hayward Hill Study[1] This report contains detailed discussions of all natural physical-biological conditions unique to the Hill Area in Alameda County.

Less often mentioned, but more in need of reduction of all forms of pressure from human interference (through coordinated planning), is the narrow and fragile Bay marshland lying between San Leandro and Fremont.

The remnants of what was once an undisturbed system of marshes and estuaries provides the diversity of habitat necessary to support many species of aquatic and terrestrial animals. The extensive salt evaporation ponds have provided a unique and sensitive habitat. The abundance of animal life in this rich habitat is a continuing proof of the health and vitality of the area.

Introduction[2]

Historically, most of the Hayward Shoreline Study Area was subject to tidal action, either as mudflats or salt marsh. The remainder were uplands probably covered with grassland or brush. Old accounts tell of abundant marine life in the Bay, including sea otters and salmon. The present land use is dominated by man's activities; the marine life is vulnerable to man's pollution of the Bay.

Most of the original salt marsh has been diked off from tidal action and thus destroyed. In the portion north of the San Mateo Bridge, the diked areas are mainly dry and are used for sanitary landfill and grazing. In the portion south of the San Mateo Bridge, most of the diked land is in salt ponds.

The shoreline environment or ecosystem (involving the interrelationship of organisms and environment) consists of many parts: open water in the Bay; mudflats exposed at low tides; shoreward stands of cordgrass; and landward, pickleweed. The vegetation serves as the broad food base for marsh and bay animals, and as habitat for many species.

Six different ecosystems have been recognized in the Shoreline Area: SHALLOW BAY WATER, TIDAL MUDFLATS, SALT MARSH, SALT PONDS AND DIKES, MINOR MISCELLANEOUS HABITATS (dry dikes areas and seasonal fresh water ponds, and upland habitats: fields and pastures, isolated hills, and residential-industrial areas).

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[1] Hayward Planning Department, Hayward Hill Area Study, April, 1971.

[2] This report is excerpted from Hayward Shoreline Environmental Analysis. It is entitled "Ecology" written by John Werminski.

SHALLOW BAY WATER AND TIDAL MUDFLATS

These two important habitats are represented by some 9,500 acres in the planning area. In some respects the open bay and mudflat areas appear to be distinct entities, but on the other hand, they are united by a number of physical and biological circumstances into a larger ecological unit which is difficult to subdivide.

The bay shoreline environment is dominated by a tidal rhythm that consists of two high tides of unequal magnitude and two low tides also of different heights during the course of a 25-hour "lunar day." Although this constant movement of tremendous quantities of salt water affects the open bay, tidal influences are most dramatic along the strip of periodically-exposed mudflats - the intertidal zone.

The shallow bayshore waters of the planning area teem with a wide variety of minute marine organisms that form the first links or base levels of food chains and energy pyramids that eventually incorporate all the larger fish, birds, and mammals that live, feed, and die along the edge of the bay. The microscopic planktonic plant life is dominated by diatoms, with over 25 genera found in San Francisco Bay.

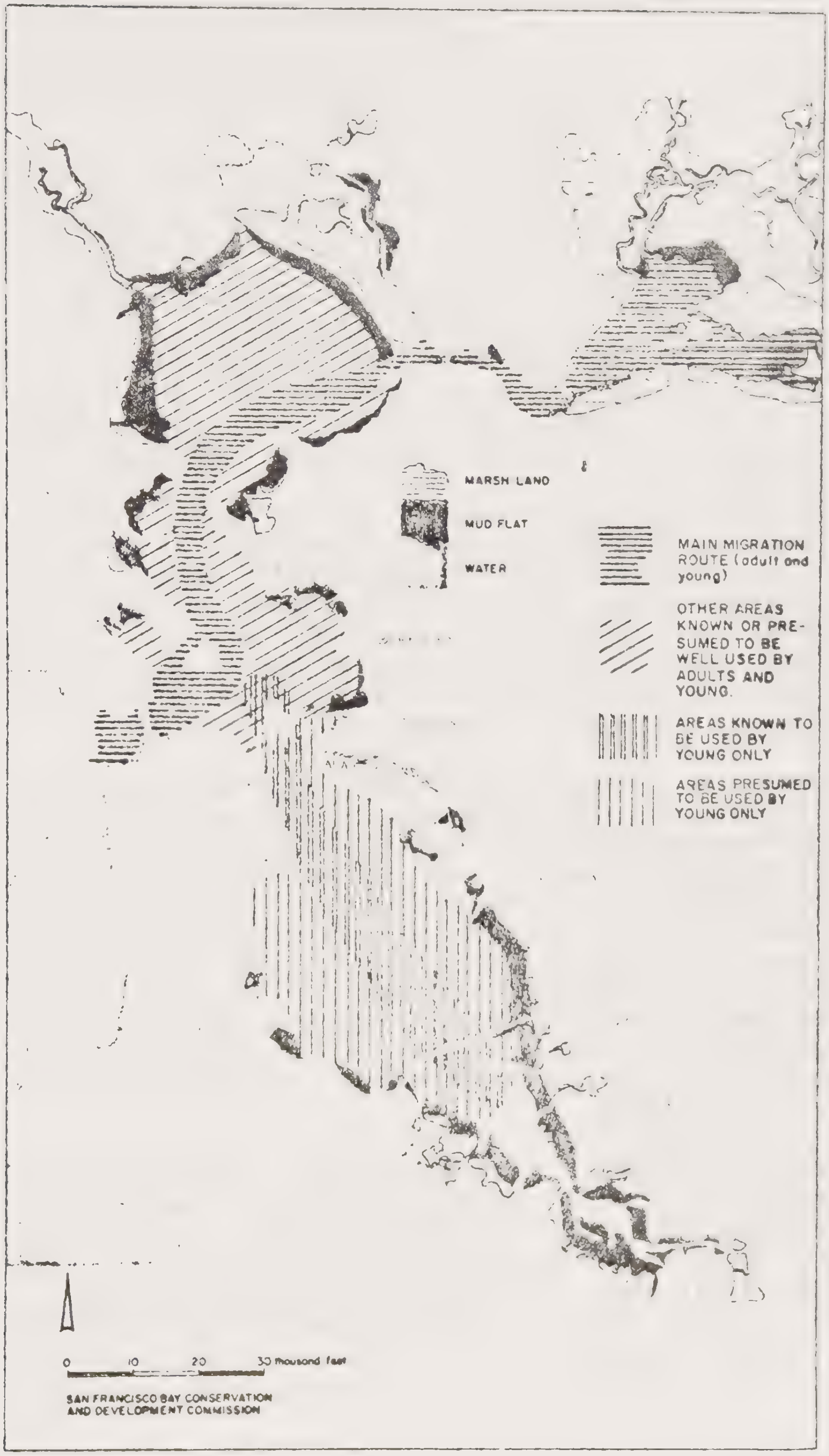
In terms of minute animals life, protozoans are similarly quite abundant - sometimes to the degree of twenty thousand per quart of salt water - and include at least six different genera, mainly ciliated and flagellated forms. In addition, Harvey (1971) recognizes four major groups of planktonic invertebrate animals in the bay that feed on the microscopic marine life and in turn are preyed upon by larger forms. They are (1) polychaete larvae (segmented worms), (2) copepods (crustaceans) - the most abundant, in concentrations of up to 75 per quart, (3) fish larvae, and (4) snail larvae. Also, there are two ecologically important types of shrimp that inhabit the local waters: the Black-tail Shrimp (Crago nigricauda), and the Bay Shrimp (Crago franciscorum), once highly prized for human food.

About 125 species of fish have been reported from San Francisco Bay, some of which are known to be quite abundant. Great numbers of Striped Bass (Roccus saxatilis) come through the bay to spawn, as do some Steelhead Trout (Salmo Gairdnerii). Certain bait fish like Northern Anchovy (Engraulis mordax) and bottom fish like shiner Seaperch (Cymatogaster aggregata) are very numerous as well. While there is evidence that the diversity of fish species decreases southward in San Francisco Bay, at least twenty South Bay fish attain some degree of commonness. Seventy species were found by the California Department of Fish and Game in a 1963-66 study in the central and south parts of the bay. At the closest station, although seven miles northwest of Hayward, from 2 to 17 species were found per month by sample (average 9). Those in greatest numbers were the Northern Anchovy, Pacific Herring, Jacksmelt, Shiner Perch (May, December) and English Sole.

The thriving community of organisms that live on and in the bay muds is a major element of the shoreline environment. Here as in the shallow water, plants and animals range from microscopic to moderate-sized forms. Many of them serve as initial or intermediate steps or links in chains of food, transfers of energy, and in webs of interrelationship which often extend beyond the muds to the open water or may reach inland to the bay plain.

PLATE 5

SALMON AND STEELHEAD TROUT IN SAN FRANCISCO BAY



Source : S. F. Bay Conservation and Development Commission, San Francisco Bay Plan Supplement, page 48.

Like the shallow water, the moist bay muds are inhabited by large numbers of small, relatively simple forms of life. Single-celled blue-green algae may abound on the surface, and types of multicellular red algae and green algae (such as the conspicuous Sea Lettuce, (Ulva sp.) may be found in quantity as well. Even so, the chief photosynthetic organisms are probably benthic (bottom-dwelling) diatoms, found within the upper centimeter of the muds.

Well over one hundred species of invertebrates have been collected from San Francisco Bay muds. Among these are certain roundworms (nematodes), ribbon worms (nemerteans), and such segmented worms (annelids) as Nereis diversicolor and the Pile Worm, Neanthes succinea. Crustacens present in or around the muds include small amphipods (such as Ampelisca milleri), commercial crabs (Cancer magister), and Shore Crabs (Hemigrapsus oregonensis), with barnacles (Balanus spp.) living on nearby objects. The east shore community of burrowing animals includes a number of moluscs - both "filter feeders" (strainers) such as mussels and clams the commonest species being the Macoma Inconspicus, and "deposit feeders" (that ingest mud) like the California Horn Snail (Certhidea californica).

The complex biological environment that has been outlined above is indispensable for supporting the huge populations of waterfowl that seasonally visit the shallow waters and mudflats of San Francisco Bay. Cogswell (1973) lists 94 species of waterfowl that have been observed in the Hayward shoreline planning area; of these, 72 can be expected in the bay or on the tideflats. They range from rare winter visitants like Whistling Swans (Olor columbianus) and Snow Geese (Chen hyperborea) that are only irregularly seen to massive flocks of Western Sandpipers (Ereunetes mauri) that at times may number one hundred thousand or more.

In many respects the highly-conspicuous waterfowl population seems to dominate the total wildlife picture along the edge of the bay. Annually the Pacific Flyway deposits additional hundreds of thousands of migrating birds to whom San Francisco Bay is a vitally important feeding and resting area. Some pass through in spring and fall, while others stay to winter in the shelter of the bay. When these are temporarily added to the resident breeding waterfowl population, the numbers of birds found locally can attain remarkable proportions: densities of up to twenty thousand shorebirds per shoreline mile have been reported. In all, South Bay shoreline habitats supply food, shelter, and resting places through the winter for perhaps seventy percent of all the diving ducks and shore birds of the Pacific Flyway. The South Bay and within it, the Hayward Shoreline area supports major segments of these large numbers.

While the implications of such sheer numbers can be staggering, the dynamic, ever-changing nature of the waterfowl population is equally as impressive from an ecological point of view. The over-all population is always in a state of flux - a dynamic equilibrium - as the component species alternately arrive and leave to add or subtract their numbers from the total, and so from week to week the waterfowl picture changes in terms of dominant types and relative numbers. Even during the course of a day the shorebirds shift from place to place within a given area as the tidal rhythm superimposes itself upon the longer seasonal cycle.

As was mentioned earlier, waterfowl ecology in our area is inextricably bound to the bayshore muds and shallows with their diversity of invertebrates and fish. Since most waterfowl seem to be capable of detectihg differences between the two common shore area habitats, one of the most useful ways to distinguish bay water from tideflats is by a comparison of their bird populations. As a rule, the open bay waters are visited by loons, greves, pelicans, cormorants, geese, mergansers, phalaropes, and terns, and are also preferred by most diving ducks; when disturbed, several of the "dabbling" ducks will leave shore to congregate in floating "rafts" on the water as well. Conversely, tideflats host herons, egrets, plovers, avocets, stilts, and probing shorebirds.

The environmental importance of the bay water-tideflat complex is considerable. Plant productivity for the mudflats may in places exceed two thousand pounds per surface acre, a figure which - in the absence of pollutants in excessive sedimentation - could even be increased. Together, the phytoplankton and bottom-dwelling vegetation of the water and mud operate as an "interdependent biochemical factory" that harnesses solar energy, releases oxygen, absorbs carbon dioxide and hydrogen sulfides, and fixes carbonates, nitrates, and phosphates. Much of this material is transformed through a variety of channels and organisms to ultimately provide the wealth of invertebrate and vertebrate animal life that characterizes the bayshore environment. The ebb and flow of tides maintain a vital circulation system that disperses nutrients that come from within and beyond the shoreline area.

SALT MARSH

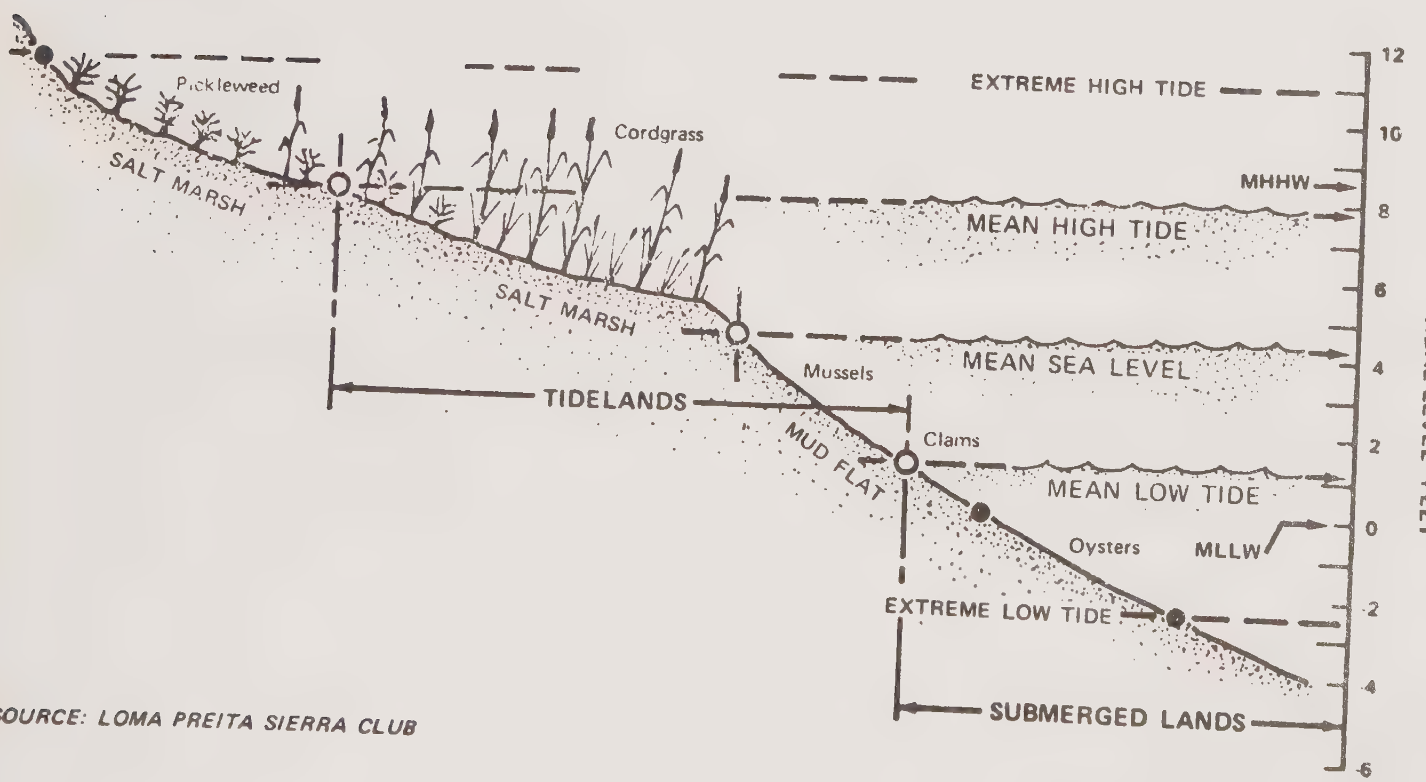
At one time the salt marsh habitat was one of the dominant elements of the Hayward shoreline, both in terms of the area it covered and in its ecological significance. Today in the planning area, less than four hundred acres remain - about five percent of the original total - that still deserve this designation. There are two major salt marsh areas, encompassing approximately 250 acres, located north and south of the mouth of the Alameda Creek Flood Control channel. A third diked marsh of moderate extent has been mapped northwest of Turk Island, along Plummber Slough, elsewhere, lesser strips and patches can be found along some of the creek channels and bordering parts of the bay.

Salt marshes generally occur at levels slightly higher than (and inland from) the tideflats but, like the mudflats, exist in a "not-quite-water, not-quite-land" situation. The environmental rigors of a salt marsh community include, among others, regular fluctuations of temperature and tide. To plants and animals alike, the salt marsh is a "chemical desert" with a scarcity of fresh water, a salty, alkaline soil, and an exposure to the drying effects of wind and evaporation - conditions which in many ways are as severe to life as those of a climatic desert.

Salt Marsh Vegetation

Most types of Bay Area vegetation, whether native or introduced, would find such environmental conditions prohibitively hostile. But in the salt marshes two major plant associations have evolved to utilize and flourish under these circumstances; together, they form the basis of a remarkably rich and productive habitat. In our area each of these associations is dominated by a single plant species: generally speaking, most salt marsh acreage consists of a solid, dense groundcover of Pickeweed (Salicornia sp.), with strips of Cordgrass (Spartina foliosa) occuping the shallow sloughs. Studies have shown that substratas usually have a lower shear strength and dry density under Cordgrass than under a Pickelweed marsh, and that soil erodibility and moisture content tend to be higher when associated with Cordgrass than with Pickelweed. Cordgrass is tremendously important in the economy of a salt marsh because of its extremely high productivity. Termed the "staff of life" for bay animals, it helps purify the air and produces five to ten times more nutrient material and oxygen per acre than well-known commercial crops such as wheat. Although it provides habitat and foraging niches for certain animals, Cordgrass become most ecologically valuable when it decomposes, thereby releasing nutrients that are washed into intertidal water to feed invertebrates and fertilize algae beds.

Unlike Cordgrass, which can endure up to 21 hours of continuous submergence, Pickleweed - the most widespread salt marsh plant - is less water tolerant and begins its best growth at the average high tide line. Its curious, succulent stems are characteristic of bayshore soils with salt contents as high as 6½ percent, and its root masses give stability to the banks of brackish channelways.



*SOURCE: LOMA PREITA SIERRA CLUB

Wildlife of the Salt Marshes

A variety of insects can be found in or around the salt marshlands, including moths, butterflies, beetles, ants, wasps, bumblebees, and the like. As its name implies the Salt Marsh Fly (Ephydra spp.) lives only around the marshes and salt ponds; likewise, the Salt Marsh Mosquito (Aedes Squanmiger, A. dorsalis) lays its eggs in quiet marshland ponds away from tidal currents.

Some salt marshes around San Francisco Bay play host to common shallow water fish such as anchovies, smelt, sculpin, and surfperch at high tide, with Three-spine Stickleback (Gasterosteus aculeatus) sometimes remaining in nearby sloughs and potholes; however, it is not known if such species inhabit marshlands of the planning area. Similarly, Gopher Snakes (Pituophis catenifer) are reputed to invade upper salt marsh areas in the South Bay, but observations have not confirmed this along the Hayward shore.

In the planning area some 27 species of birds have been observed in salt marsh habitat, and at least eight others - perhaps more - may be found there from time to time as well. Over half of these are waterbirds, including a relatively high proportion of "wading" birds, probing shorebirds, and rails, while the rest are species usually associated with adjacent inland areas, such as hawks, insectivorous birds, and others. Two of these birds, the Clapper Rail (Rallus longirostris) and a subspecies of Song Sparrow (Melospiza melodia pusillula), are critically dependent upon the salt marsh habitat for their survival. An estimated thirty to fifty Clapper Rails - officially listed by the U. S. Fish and Wildlife Service as an endangered species - live in the patches of salt marsh at the mouth of the Alameda Creek channel, where they nest amidst the Pickleweed. Cogswell (1973) believes the Black Rail (Laterallus jamaicensis), rare to our area, may occur there as well.

The Song Sparrow subspecies, also a local resident, is restricted in its range to salt marshlands and adjacent dikes about San Francisco Bay from Richmond southward; probably their total population in the planning area is at least three to four hundred. In addition, the bulk of the planning area lies between the known ranges of a rare species of Salt Marsh Harvest Mice (Reithrodontomys spp.), the Red-bellied Harvest Mouse (R. raviventris), endemic to South Bay San Francisco, San Pablo and Suisun Bay salt marshes, and a close relative, the Western Harvest Mouse (R. megalotis), which is widespread over most of western United States. Interestingly, the Red-bellied Harvest Mouse feeds on Pickleweed, drinks salt water, and excretes salt with its urine. By elimination of its habitat, this species is threatened with extinction. In our area, Harvey (1971) suggests that one of the two may possibly inhabit the salt marshes at the channel mouth of Alameda Creek.

Ecological Overview

Despite their spatial limitations, the strips and patches of salt marsh along the Hayward shoreline occupy a prominent place in the over-all environmental picture of the planning area. They support a wealth of interrelated - and sometimes specially adapted - organisms that range from inconspicuous algae growing on Pickleweed stems to graceful Marsh Hawks soaring overhead. They have served as part of a special "evolutionary laboratory" that today provides sanctuary for several rare and endangered species. And their luxuriant swaths of Cordgrass have helped earn the salt marshes their position as the most productive type of natural vegetation in North America.

For the ecological reasons outlined above, salt marshes should be given very high environmental priority in any plan for the use of bayshore lands.

SALT PONDS AND DIKES

Salt Production

Around South San Francisco Bay, much of what were formerly inland tidelands have been diked to create evaporating ponds for salt extraction. In the planning area, slightly over five thousand acres are presently in diked and ponded areas, and additional land, now dry, can be recognized as prior salt pond sites.

Salt ponds represent one of the most variable planning area habitats from the standpoint of the plant and animal life they are capable of supporting. Dissolved oxygen levels in the water increase and decrease significantly through time, creating a problem for pond life that is aggravated at night because aquatic plants consume, rather than release, oxygen in the dark, thereby further reducing the amount of this vital gas. In fact, decaying organisms can totally deplete the available oxygen at times, locally creating what is termed an "anoxic" situation. The availability of nutrients may likewise beomce a limiting factor for life and growth, as nutrient materials are rapidly assimilated by plants and animals in the low salinity ponds and remain "tied up" there until they are eventually released by bacterial action. All of these elements contribute to the rigors of the salt pond environment.

Even so, an interesting diversity of living forms inhabit at least some of the salt ponds. Probably the major food-producing organisms are a variety of algae and dinoflagellates. Rotifers, roundworms, and Mud Snails (Nassarius sp.) are among the invertebrate animals that flourish in some of the salt ponds, feeding on the algae and on each other. Other common to abundant organisms include Scuds or Fairy Shrimp (Callianassa sp.), Brine Shrimp (Artemia salina), copepods, Waterboatman (Trichocorixa reticulata), Brine Flies (Ephydra cineria), seed shrimp, and polychaete worms.

Certain fish may also inhabit the salt ponds. Threespine Sticklebacks (Gasterosteus aculeatus) are sometimes prevalent in low-salinity waters, while Topsmelt (Atherlinops affinis) are capable of tolerating slightly high salt concentrations. Above six percent salinity the last remaining fish perish. The mudsucker, (Gillichthys mirabilis) survives in salty water and has been grown commercially as bait fish in some of the Leslie Salt Company ponds.

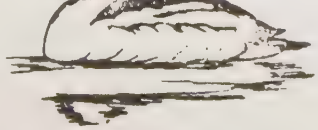
CLAPPER RAIL
(RARE AND ENDANGERED)

WHITE PELICAN

LEAST TERN
(RARE AND ENDANGERED)

BLACK-NECKED STILT

SONG SPARROW
(RARE AND ENDANGERED)



BUFFLEHEAD

RED-BELLIED HARVEST MOUSE
(RARE AND ENDANGERED)

Waterfowl of the Salt Ponds

Of vertebrate animals that inhabit the salt pond areas, birds are by far the most conspicuous. In one study of five ponds during a two-year period (Anderson, 1970), over three hundred thousand birds were sighted in an area of about 2,500 acres. Comparable waterfowl abundance can be demonstrated in the Hayward shoreline planning area - ducks have been seen in concentrations of over ten thousand per square mile on local low-salinity ponds, while 17,000 Ruddy Ducks (*Oxyura jamaicensis*) have been sighted in one day on two salt ponds south of the old Alameda Creek channel.

Bird diversity also tends to be unusually high in the salt pond habitat. Of the 94 waterbirds that have been observed in the planning area, better than 65 - over seventy percent - have been sighted in salt pond areas; and interestingly, at least a dozen "land" birds can be found here at times as well. Most salt pond birds also spend a good deal of time locally in other types of habitat. A large number of "open bay" species visit the ponds, including greves, geese, cormorants, phalaropes, Bonaparte's Gulls (*Larus philadelphia*), and terns, while Scaup (*Aythya sp.*) and other ducks feed heavily on the ponds, especially in rough weather. Similarly, many mudflat birds - such as herons, egrets, plovers, probing shorebirds, American Avocets (*Recurvirostra americana*), Black-necked Stilts (*Himantopus mexicanus*), and gulls - can be found in salt pond areas, especially during periods of high tide. Black-bellied Plovers, and nearly all the species of Sandpipers (i.e., the bulk of the tideflat feeders) use the salt ponds during high tide periods primarily for roosting. A few birds even show strong preference for the salt pond habitat such as the White Pelican (*Pelecanus erythrorynchos*) and the Eared Grebe (*Podiceps caspicus*) and the Bufflehead (*Bucephala albeola*), a diving duck, also occur most regularly on salt ponds, particularly those of middle-range salinities where Brine Shrimp abound. Also, all of the world's three existing phalarope species - the Red Phalarope (*Phalaropus fulicarius*), Wilson's Phalarope (*Steganopus tricolor*), and the Northern Phalarope (*Lobipes lobatus*) - occur on salt ponds of the Hayward area shoreline as migrants, two of them seeming to show marked preference for those ponds over other local habitats.

Recent studies of the relationship between salt ponds and wildlife have revealed some interesting facts about the food sources of salt pond waterfowl. Greves, for instance, were found to ingest quantities of Brine Shrimp; shorebirds ate considerable numbers of Brine Fly larvae and puparia; Water-boatman appear to be a key food item of phalaropes; and polychaete worms were an important source of nourishment to Willets. Some birds exhibited dietary habits that may restrict them to certain of the ponds; as one example, certain ducks consumed rather high proportions of Widgeon Grass seeds, which in turn are produced only in ponds of relatively low salinity. In any event, waterbirds are not evenly distributed along the salt pond salinity sequence. Dabbling ducks, Coots, and fish-eating birds (such as terns, egrets, mergansers, and pelicans) prefer waters with the lowest salt content. On the other hand, diving ducks, grebes, phalaropes, and Bonaparte's Gulls demonstrate a high degree of salinity tolerance and a preference for food items existing in ponds of higher salinity. Shorebirds, however, will use for roost purposes ponds that are shallow enough for wading, irrespective of salinity.

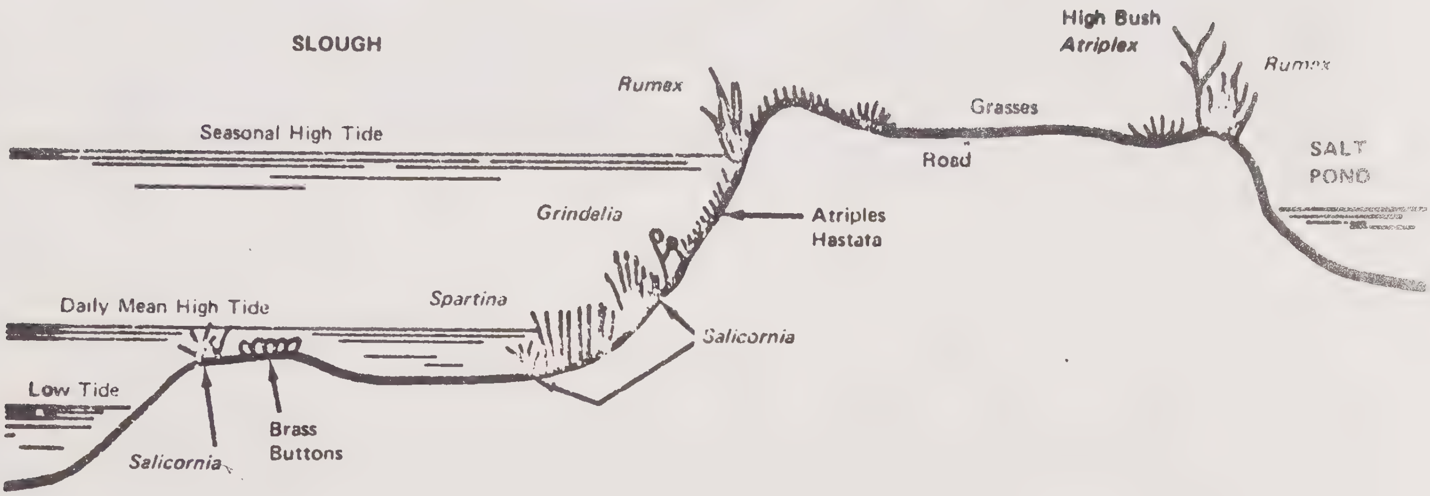
Harvey (1973) has tentatively ranked salt ponds of the planning area according to relative wildlife value. Based on cursory observation he would, in general, rank the ponds between Coyote Hills Slough and Alameda Creek as highest in wildlife value. The western section of ponds between Alameda Creek and the San Mateo Bridge were ranked as of moderate value, and those of the eastern portion were thought to have a low value. Also, the ponds north of the approach to the San Mateo Bridge appeared to be of moderate value. However, it was explained that a study over at least a year's time would be necessary to confirm these estimated evaluations of the ponds.

The Dike Environment

Of 28 plants that were found growing on the dikes of the salt ponds, 21 of them are alien (not native to the area). For the most part these are plants that colonize disturbed areas, and that are able to successfully compete for space against native species by virtue of their modifications for enduring drought, their high reproductive rates, and in most cases by an annual (single growing season) life style. That three-fourths of these plants are adapted to the man-made dike environment tells us, in effect, that their presence is more the result of human intervention in the area than of any inherent biological richness of this particular habitat. This situation contrasts clearly with that of the salt marsh, where the entire habitat is dominated by native plants such as Cordgrass and Pickleweed. Transition plants found between marsh and dike - such as Marsh Grindelia, Fat Hen, and Alkali Heath - are native to California as well. Unlike many of the aliens, these natives represent stable forms whose long-term presence in the region has allowed them to integrate into complex ecological associations; as an example, Marsh Grindelia is a valuable forage plant for many insects, such as bees and butterflies, and also for seed-eating birds. For such reasons, as well as for their historical significance, the native plants must be regarded as important and valuable members of the natural community.

In our area certain waterbirds - avocets, Black-necked Stilts, Forster's Terns, and Snowy Plovers - frequently nest on dikes; and from a regional standpoint, several Caspian Tern nesting colonies on salt pond dikes in San Francisco Bay are important ones in North America. Whether for nesting or for roosting, one main reason that dikes are useful for waterfowl is because of their isolation. Cogswell (1973) believes that such areas, protected from disturbance by humans, dogs, motor vehicles, and the like, are one of the most critical habitat features for probing shorebirds in a metropolitan area.

TYPICAL SLOUGH – SALT POND LEVEE CROSS SECTION*



* *SOURCE: ADAPTED FROM TUDOR – 1972*

Ecological Overview

In the last analysis, the planning area's salt pond-dike system is something of a biological anomaly. The levees, power lines, and concentrations of brine underscore the highly altered nature of this environment, which has been described as "an intricate and fascinating system, a part of the largest solar evaporation plant complex in the world, and a colorful and important segment of the industrial community of the San Francisco Bay Region." As a setting for life, the value of this habitat can be exceedingly variable, ranging from barren, salt-encrusted margins of some of the ponds to spectacular displays of pelicans, egrets, and herons that can be found in season - at the right places. The areas on and around the dikes are home to a curious sequence of high-adopted plants that live under conditions which are prohibitive to the vast majority of members of the plant kingdom.

Besides serving as a wildlife habitat, salt pond areas have several other values that extend beyond the limitations of salt production. They support compatible commercial enterprises like brine shrimp production and marketing of bait fish. Waterfowling leases are an additional area of economic and recreational interest; in our area, duck hunters visit Leslie Salt Company ponds as well as the gun club ponds to the east of them.

MINOR MISCELLANEOUS HABITATS

Limited acreages of two other habitat types occur in the planning area: diked dry areas and freshwater ponds. Because they play relatively minor roles in the overall ecological pitcure, they will be treated briefly here.

Dry Diked Areas and Dumps

About 1,700 acres of planning area terrain are presently diked off and relatively dry. Since some of this area is composed of previous salt ponds, relatively high salinity can be a limiting environmental factor. For this reason and because of their aridity, Harvey (1973) considers these areas to be particularly low in ecological value since they lack much life; but he notes that, like low-value salt ponds, they serve as open-space areas that do not contribute greatly to air pollution and do not restrict air movement - thus are ecologically more valuable in their present state than they would be if urbanized.

Of some interest is the dump at the end of West Winton Avenue, which belongs to this general habitat type. As a rule, sanitary fills tend to smell bad and are unsightly; in addition, rainfall-leaching (and flood-leaching) in dump areas can result in seepage of polluted water and contamination of the environment. Despite these detrimental impacts, however, considerable wildlife may be attracted to disposal sites. While sanitary fills are never balanced ecosystems - vegetation cannot find a foothold in an active site - the fill does contribute a supporting food niche to adjacent habitats. In particular, hordes of gulls are commonplace - up to 13,000 of these birds have been reported in winter at the Winton Avenue site.

Seasonal Freshwater Ponds and Related Habitats

Limited amounts of shallow freshwater habitat are present in the planning area, the exact acreage varying with the time of year. This important, non-saline aquatic element is provided primarily by gun club ponds, the oxidation ponds of the sewage treatment plant, and winter floodplain accumulations. Freshwater habitats in general - ponds, marshes, or others - often contain a variety of green plants which, in turn, support a diverse pyramid of life, from aquatic micro-organisms to the larger, more conspicuous forms.

"Upland" Areas

In addition to its other major habitats, the Hayward shoreline planning area contains over two thousand acres of land which have been collectively termed "upland" terrain. These uplands occupy an irregular strip along the northeastern boundary of the planning area behind the mudflats, salt marshes and salt ponds; essentially they are part of the extensive "bay plain" region upon which San Lorenzo, Hayward, and Alvarado have been built. They include land now in residential or industrial use (not discussed here) and also grassy or weedy land which now lies fallow. Much of the area is underlain by a substratum which is too high - in some cases only by a matter of a few feet - for tide flooding. While parts of it may be flooded by winter rains, the land is comparatively dry. Salt or brackish water often lies only a short distance below ground level, so that deep-rooted plants do not grow well. Prolonged exposure to sun and wind are other limiting physical elements of the fallow upland habitat. In terms of component vegetation the open upland areas closely resemble the dikes, except that many of the native salt-tolerant species may be absent. As on the dikes, several important non-native grass species are joined by a diverse group of other non-native herbaceous plants, resulting in a 'weedy' groundcover that extends beyond the fields and pastures to re-invade the fringes of adjacent developed areas.

Fields and other undeveloped upland areas are capable of providing habitat for an interesting variety of animals. A wide variety of insects are found here. Reptiles include the Western Fence Lizard (Sceloporus occidentalis) and the Gopher Snake (Pituophis catenifer). A large proportion of the planning area's 'land bird' species are associated with relatively undeveloped upland habitats, and a number of water birds sometimes find their way into the area as well. Common mammals to be expected include, among other, Black-tailed Jack Rabbits (Lepus californicus), Gophers (Thomomys bottae), California Ground Squirrels (Citellus beecheyi), and California Meadow Mice (Microtus californicus). In the uplands, as elsewhere, an interlocking web of life binds many of these forms together.

Isolated Hills

Near the southern boundary of the planning area a pair of small hills rise conspicuously above the bay plain. Physiographically these are a northern extension of the Coyote Hills, and the most prominent of the two, known as Turk Island, attains a maximum elevation of only 116 feet above sea level. Even so, this difference in height, slope, and substrata - and perhaps in human land use - is sufficient to produce a marked change in the vegetation of these areas and to permit many wildflowers and other plants to flourish on these low hills that may be absent or uncommon elsewhere in the planning area.

For the most part, the plants of these hills are quite typical of grasslands throughout the coast ranges of central California and are therefore not actually rare or endangered species. But in the larger sense, the isolated nature of the hills places them in an ecological situation which - in its undeveloped state - is quite uncommon along the shore of San Francisco Bay. Well over forty different kinds of plants are found on or at the foot of the hills. In a vegetational sense, then, the hills should be ranked among the richest and most diverse of habitats to be found in the planning area.

Planning Implications

In the Hayward Shoreline area are major habitats that are more valuable than others. The salt marsh is most valuable, followed by open water, mudflats, and some salt ponds. Upland areas and dry diked areas rank lowest.

From every ecological standpoint, the small patches of salt marsh at the end of the Alameda Flood Control channel should remain inviolate. Because of the dependence of several rare species on this specific habitat (including the Clapper Rail, a subspecies of Song Sparrow, and possibly the Salt Marsh Harvest Mouse) and because of the extremely high productivity of its biological system, the existing salt marsh areas should definitely be retained.

Other suitable shoreline areas (such as some low-salinity salt ponds) should be encouraged to revert to this habitat form.

Other areas exposed to tidal action - the mudflats and open waters - should be exempted from further development. They are necessary for the support of large, attractive migratory waterfowl populations, and they are instrumental in the circulation of nutrients upon which the bay's fishery depends.

Diking of the bay greatly diminished wildlife values in many areas and continued filling would be unwise. Sanitary filling destroys habitats of biological worth.

If salt production is curtailed, low-salinity ponds may be re-exposed to tidal action through dike breaching and in a relatively short time should revert to high-quality salt marsh.

Some low to moderate salinity salt ponds should be retained since a wide variety of water birds use them.

Salt pond dikes possess a biological value primarily as root sites and should not be disturbed.

Freshwater habitat is nearly absent in the planning area. Any increase in the acreage of freshwater ponds would be desirable and highly beneficial to wildlife.

The residential and industrial areas of the "uplands" have low ecological values, however the isolated hills in the southern portion, in particular, contain biological features (an uncommon plant assemblage) that merit their preservation.

The wildlife habitat should be preserved as there is little likelihood that the waterfowl using the existing habitat will go elsewhere. A reduction in habitat almost always demands a further reduction in animal numbers.

The planning area could continue to support limited salt production as well as other compatible enterprises such as brine shrimp harvesting, bait fish marketing, and perhaps waterfowl hunting leases.

Shoreline access must be supervised, limited, and directed to avoid disturbing some areas of water fowl concentration.

D. Vegetation and Wildlife Resources (Continued)

2. Biotic Resources of Livermore-Amador Planning Unit:

a. <u>Introduction</u>

Approximately seventeen thousand acres of the Livermore-Amador Planning Unit is developed in urban uses. The remaining 247,490 acres are in various agricultural and open uses. Valley lowlands and some of the rolling foothills around the lowlands are intensively cultivated for field and row or fruit crops. Upland areas are extensively farmed for cattle grazing or left in open space because of limitations inherent. The upland areas provide suitable habitats for many species of plants and animals in Alameda County. This section will discuss the biotic resources in Alameda County and specifically the biotic resources in the Livermore-Amador Planning Unit. The preservation of natural resources begins with an understanding of the composition of natural communities and how those communities are classified. Our discussion will define the common natural communities found in the Livermore area.

Resource conservation objectives will be presented to reflect the important areas in which policy should be developed.

b. Classification of Natural Communities - Inland Areas:

The mapping of all natural communities in any area would result in a map showing a mosaic of associations of various indigenous plants and animals. The distribution of plants and animals is determined by a variety of physical & environmental factors. Conditions such as moisture, temperature, humidity, rainfall, evaporation, slope, geology, and soils, to mention a few, are all variables affecting plant and animal populations. Distribution of plants and animals is also determined by social factors. Adaptation, feeding or nutrient requirements, range, cover, food chains, and discrete inter-species activity will affect the composition of associations. Convenient systems of classification of natural communities based upon the frequently observed association of plant and animal species have been developed and documented. One system, developed by A. C. Smith, divided natural communities found in Alameda County into freshwater marsh, grassland, riparian (stream), woodland, broad leaf evergreen forest, oak woodland, and chaparral (brushland). Other systems of classification exist which describe the association or consociation of plants and animals based upon individual size and distribution, physical habitat, or functional attributes of the species; but for the ease of understanding in this presentation, the system devised by Smith will be used.

It should be mentioned early that human interference plays a very important role in the evolution and adaptation of plant and animal associations. In many instances, the extensive or intensive use of the land by man arrests or changes the natural species inter-action significantly. Introduction of exotic species by early settlers has resulted in their out-competing the native species. Land development and its impact on the surrounding ecosystems is also not an insignificant agent of change and interruption.

When assessing the ecological status of the communities exhibited in the County, a number of principles must be kept in mind. Smith bases his breakdown on the dominant or indicator species present in the community. Dominant species are commonly thought to control the nature and functioning of the entire community.[1] Dominant species may represent

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[1]See Odum, E, P., Fundamentals of Ecology, Third Edition, 1971, Saunders, Philadelphia.

a climax or subclimax condition of vegetation development. Ecosystem development occurs in a series of stages or successions which is reflected in the changing structure of the community in time. Stages in the succession leading to a stable condition known as a climax community may occur as an orderly process of change. Changing physical factors which result from the growth and development of community diversity cause the disequilibrium which causes the succession to occur.

Climatic climax communities are highly diversified yet organized associations of plants and animals which are in equilibrium with the climate. A climax community is a terminal community.

The biotic communities described in Alameda County herein have undergone direct manipulation by man for several centuries. The direct interaction between man and nature usually arrests the process of natural succession to a climax community; what we see today in many areas are subclimax communities. The best example of this is intensive and extensive agriculture in many lowland sections of the Livermore-Amador Planning Unit.

There are eight different biotic communities in Alameda County as identified by Smith. The lowlands of the Livermore Valley are dominated by urban and rural communities and on the fringe give way to grassland; riparian woodland and freshwater marsh communities may be found at various spots along the major drainages in the Valley.

Among the easiest communities to identify are the urban, rural cultivated areas and the riparian woodland. Riparian communities may or may not be developed to the extent indicated in Table 1-5 ,depending upon whether there is enough water flowing in the drainage to support the indicator species. Where the drainage flow is seasonal, the vegetation will more closely resemble the surrounding community; for example, grassland or oak woodland. The Grassland community is relatively easy to identify from the indicator species listed in Table 1-5. Careful scrutiny will reveal that some fields thought to be grassland at a distance are actually dry farmed field crops. There are extensive areas within the Livermore lowlands which are moderately productive when dry-farmed for field crops such as wheat or barley. True grassland may be observed in those areas which are not farmed and which don't contain scattered oak.

Intermediary between the grassland community and the broadleaf evergreen forests is the oak woodlands. The eastern end of Alameda County receives only about eleven inches of rainfall per year, compared to fourteen inches in Livermore and twenty-six inches in Oakland. The arid condition of the foothills in the Altamont area provides an ideal climate for the oak woodland. This prairie or savannah type of community is exemplified by the predominance of grassland with scattered oak (Quercus agrifolia) occurring throughout the area, frequently in the bottom of gullies through which seasonal rainfall drains. A good example of the oak woodland would be Brushy Peak northeast of Livermore. The foothills south of Livermore and Pleasanton also contain many examples of this community.

TABLE 1-5. Lowland Biotic Communities of Livermore Valley

I.	Urban	Cities, towns, subdivisions, parks, etc.	Introduced trees and shrubs; House Finch, English Sparrow, Norway Rat, House Mouse, Cockroach.
II.	Rural	Cultivated crop lands and pasture.	All varieties of truck and row crops, fruit crops; Barn Owl, Sparrow Hawk, Brewers' Blackbird, Gopher, Vole, Gopher Snake, Alfalfa, Cabbage Butterfly.
III.	Riparian Woodland	In wooded canyons along stream courses.	Western Sycamore, Fremont Cottonwood, Red Willow, Arroyo Willow, Big Leaf Maple; see appendix for faunal indicator species.
IV.	Grassland	Non-cultivated areas in Livermore Valley and adjacent hills.	Blue Bunch Grass, Calif. Oat Grass, Foothill Sedge, brome grass, wild oats; see appendix for faunal indicator species.
V.	Freshwater Marsh	Scattered areas around springs, ponds, and sluggish streams.	Common Tule, Calif. Bulrush, Common Cattail, sedge; Longbilled Marsh Wren, Red-winged Blackbird, Yellowthroat, garter snakes, etc. see appendix.

Grassland extends over much of the Altamont area from Brushy Peak to the Arroyo Seco drainage.

Higher in the hills south of Livermore the environmental conditions change significantly and grassland and oak woodland give way to the broadleaf evergreen forests and chaparral. In this section of the County, the topography becomes steep to very steep in the northwest trending hills which form the drainage for Arroyo del Valle and Alameda Creek. In this vicinity in the mid-elevations the mosaic of broadleaf evergreen forest, chaparral and grassland oak woodland is found. Chaparral is found in the higher and drier usually west-facing slopes of the uplands. Indicator species such as Scrub Oak, Chamise, Buckbrush, California Coffee Berry, Manzanita (spp.), and wild lilac (Ceanothus) form a mixed assemblage in this community which is easily recognized.

Factors such as elevation, steepness of slope, rainfall, and exposure determine the amount of dessication or evapotranspiration that occurs; and it also determines, along with the soil present, the type of vegetation which occurs in the uplands. The slopes with northeastern exposure undergo less direct sun and direct wind and thus provide a microclimate suitable for the species found in the broadleaf evergreen forest.

TABLE 1-5 . Upland Biotic Communities of the Livermore Valley

VI.	Oak Woodland	Inner coastal ranges from 400 to 3000 feet; rolling hills along north and south edge of Livermore Valley lowlands.	At lower elevations, Valley Oak, Coast Live Oak; Blue Oak, Digger Pine, at higher elevations. Throughout: Holly-leaf Cherry, Calif. Coffee Berry, Calif. Buckeye, Poison Oak.
VII.	Chaparral	Higher dry slopes and ridges generally throughout the area.	Chamise, Scrub Oak, Holly-leaf Cherry, Buckbrush, Calif. Coffee Berry, manzanita, wild lilac.
VIII.	Broadleaf Evergreen Forest	On higher hills from 200 to 2500 feet in Diablo Range	Tanoak, Calif. Laurel, Madrone, Calif. Buckeye, Golden Chinquapin, Coast Live Oak, Douglas Fir, Digger Pine.

The term microclimate is appropriately used to describe the occurence of stands of each of these communities, since the above locational patterns may be observed throughout the upland areas of the County.

At higher elevations in the upland areas, the broadleaf evergreen forest and the oak savannah blend into the modest stands of Digger Pine, Bishop Pine, and Monterey Pine. Elevations in the higher upland areas range up to 4000 feet; rainfall increases to nearly 30 inches per year at these elevations. For the most part, however, xeric conditions prevail over most of the upland areas in southern Alameda County.

Expression of Natural Communities in the Livermore-Amador Planning Unit

Urban In the cities of Livermore and Pleasanton and the unincorporated but developed areas of Dublin, Sunol, and Castlewood, native and alien species are easily observed.

Rural Adjacent to the cities, the cultivated fields form a buffer zone around developed areas. Crops such as barley, wheat, alfalfa, grapes, and others are produced in the Livermore Valley. Vegetation in the fields is almost exclusively economic crops while weeds and herbs occupy the fringes and irrigation canals. A large portion of the Valley is dry farmed field crops, especially in the area north of Livermore and Interstate 580.

Riparian Woodland In the Livermore Valley, a modified riparian woodland is best exhibited in the Arroyo del Valle drainage. Other watercourses such as the Arroyo Mocho, Arroyo Seco, and Arroyo Las Positas exhibit various stages of riparian woodland due to the low rainfall runoff patterns in the eastern part of the Livermore Valley. Upland sections of the Arroyo del Valle and the Alameda Creek drainage above Sunol offer greater potential for riparian woodland development.

Grassland In the lowlands and the rolling foothills adjacent to the cultivated agriculture, grassland communities abound. Perhaps the best example of this community is in the rolling foothills north of Livermore in Doolan and Collier Canyons extending east through the Altamont foothills and south to Arroyo Seco. Isolated stands of oak savannah may also be observed in the Altamont hills (i.e., Brushy Peak) which may be observed on aerial photos. In the upland areas south of Livermore, isolated grassy clearings may be observed interspersed with the broadleaf evergreen forests and chaparral communities. In the Altamont hills, the hot dry slopes are exposed to the afternoon sun and frequently to strong drying winds.

Numerous animals favor this community and all occupy important levels in natural energy chains and food webs. Arthropods, such as spiders, and insects, such as beetles, grasshoppers, bees, crickets, and flies, forage on the plants, decaying animal matter, and each other. Spadefoot and western toads may be found in the larger ravines where moisture is present. Lizards inhabiting the grassland include Gilbert's skink, western fence lizard, and leopard lizard. Rock outcroppings, solitary stones, burrows, and other surface objects offer shelter for these species. Insects and, to a lesser extent, bird eggs are taken for food by these reptiles. Other reptiles such as the western rattlesnake, common king snake, western and Alameda striped racer, and gopher snake may be observed in the rock outcroppings or rodent burrows.

The grassland habitat shows a limited resident population of bird species, primarily due to the lack of shelter from predators. Examples of ground nesting species which are inhabitants are the western meadowlark, savannah sparrow, killdeer, and burrowing owl. The grasslands are important for many species which, though roosting and nesting elsewhere, are dependent upon the abundant supply of seeds and arthropods or insects. Raptors, such as red-tailed hawk, sparrow hawk, prairie falcon, and great horned owl, also depend upon the grassland to provide suitable hunting grounds for their diet of rodents and small birds.

Land use in the North Livermore Area is predominantly agricultural; dry-farmed field crops and grazing constitute the major agricultural uses. In the foothills surrounding the flat areas, suitable habitat for many wildlife species exists. Immeasurable open space values are apparent in the seasonally changing vistas one obtains from the scenic routes in the area. Urban development of the area will reduce open space values. Development will also constrain the wildlife habitats significantly since many species inhabiting the Valley utilize the grassland range as a food source.

Freshwater Marsh Species in this community may be observed in the Arroyo de la Laguna watercourse west of Pleasanton. It may also be observed in the stock ponds distributed throughout the planning area and along the fringes of Lake del Valle, San Antonio Reservoir, and Calaveras Reservoir.

Oak Woodland Perhaps the most common triad of communities observed in the upland areas of the Livermore Valley are the grassland, chaparral, and the oak woodland communities. Each of these, along with stands of broadleaf evergreen forests form the mosaic patterns observed in aerial photos. The oak woodland is sometimes called oak savannah because of its resemblance to the savannahs of other arid regions. In this community, the Valley Oak and the Coast Live Oak (Quercus agrifolia, Q. lobata) predominate and form an open canopy under which grasses and herbs common to grassland communities grow. Other species associated with the Oak savannah are Holly-leaf Cherry, California Coffee Berry, Buckeye, and Poison Oak.

An isolated example of this community would be the Brushy Peak area, although it may be observed throughout the upland areas south of Livermore.

Chaparral Southwest-and west-facing slopes are subject to a greater degree of dessication than others since they absorb the full impact of the sun. Rainfall may be between 14 and 25 inches annually, most occurring in January, February, or March. In these areas, the chaparral community appears. Such species as chamise, Scrub Oak, Holly-leaf Cherry, Buck-brush, California Coffee Berry, various species of manzanita, and wild lilac (Ceanothus) characterize this community. In the chaparral, there are species which closely associate with one another such as California Coffee Berry, California Sagebrush, and Stickey Monkey-flower. Other similar associations may be observed in the chaparral and oak woodland.

Chaparral brushland may be observed in the upland areas south of Livermore. It is easily recognized by the presence of manzanita.

Broadleaf Evergreen Forest Examples of this community are widely distributed and locally abundant on northeast-and east-facing slopes between 200 and 2500 feet in the upland areas south of Livermore and Pleasanton. Similar conditions prevail in the East Bay Hills where the species characteristic of this community may also be observed together. Species such as Tan-bark Oak, California Bay Laurel, Madrone, California Buckeye, and Coast Live Oak typify the overstory in this community. Rainfall usually averages between 25 and 40 inches annually; evaporation or evapotranspiration from ground surface and plant leaf surfaces is reduced by the northeast-facing slope and the shade of the overstory of trees.

There are also important faunal species associated with the individual plant communities in Alameda County. This has been avoided because it is more desirable to point out that, while one community or another may provide prime or even suitable habitat for a species, the range of associated species is distributed over two or more plant communities. Each animal needs minimum conditions for survival which may include a portion of several plant communities. Frequently, the borders between each plant community, called an ecotone, contains the most animal activity since it offers the best of both environments. Predator-prey inter-action may be observed in the ecotones becasue of this higher amount of activity. Any list of whildlife species would then not be complete without showing food web inter-action and range characteristics.

TABLE 1-6 .

From: The Natural History of the San Francisco Bay Region, A. C. Smith

BIOTIC COMMUNITIES OF THE SAN FRANCISCO BAY REGION

COMMUNITY	LOCATIONS AND EXAMPLES	CHARACTERISTIC PLANTS	CHARACTERISTIC ANIMALS
I. Urban	Cities, towns, and subdivisions enclosing parks, cemeteries, vacant lots, and some extensive eucalyptus forests.	Great variety of introduced trees, shrubs, and garden flowers.	House Finch (Carpodacus mexicanus), English Sparrow (Passer domesticus), Norway Rat (Rattus norvegicus), House Mouse (Mus musculus), American Cockroach (Periplanata americana).
II. Rural	Cultivated crop lands and pasture lands; mostly in Santa Clara, Santa Cruz, Solano, Napa, Sonoma, eastern Contra Costa, and eastern Alameda Counties.	Alfalfa, truck crops, prune, apricot, pear, grape vines, eucalyptus, willows, and poplars.	Barn Owl (Tyto alba), Sparrow Hawk (Falco sparverius), Brewer's Blackbird (Euphagus cyanocephalus), Botta Pocket Gopher (Thomomys bottae), Calif. Vole (M. californicus), Gopher Snake (P. catenifer), Alfalfa Butterfly (Colias eurytheme), Cabbage Butterfly (Pieris rapae).
III. Riparian Woodland	Throughout the area in wooded canyons and along valley watercourses where not destroyed by man. (A) In drier interior ranges of Santa Clara, Alameda, Contra Costa, and Napa Counties. Examples - Pacheco Creek Canyon and Alum Rock Canyon. (B) In ranges west of Santa Clara Valley, north of San Francisco Bay, and in moister canyons of the northern Diablo Range. Examples - Pescadero Creek Canyon.	(A) Western Sycamore (Platanus racemosa), Fremont Cottonwood (Populus fremonti), Red Willow (Salix laevigata), Arroyo Willow (S. lasiolepis). (B) Boxelder (Acer negundo), Big Leaf Maple (A. macrophyllum), White Alder (Alnus rhombifolia), Red Alder (A. rubra), (restricted to within 30 miles of the coast).	Downy Woodpecker (Dendrocopos pubescens) Yellow Warbler (Dendroica petechia), Yellow-breasted Chat (Icteria virens), Raccoon (Procyon lotor), Western Pond Turtle (Clemmys marmorata), Calif. Newt (Taricha torosa), Lorquin's Admiral (Basilarchia lorquini), Mourning Cloak (Nymphalis antiopa), Box Elder Bug (Leptocoris trivitattus), Spotted Tree Borer (Synaphaeta guexi).

TABLE 1-6 ↓.

BIOTIC COMMUNITIES OF THE SAN FRANCISCO BAY REGION (Continued)

COMMUNITY	LOCATIONS AND EXAMPLES	CHARACTERISTIC PLANTS	CHARACTERISTIC ANIMALS
IV. Grassland	Scattered bits of coastal prairie on hills or in glades along the coast; scattered remnants of valley grassland in coastal valleys of Napa, Alameda, and Santa Clara Counties and in the Great Central Valley which enters our area in Solano County and the northeastern tip of Contra Costa County. Examples - Point Reyes and noncultivated areas in Livermore Valley and adjacent hills.	Blue Bunch Grass (Festuca idahoensis), Calif. Oat Grass (Danthonia californica), Foothill Sedge (Carex tumulicola), brome grass (Bromus spp.) wild oats (Avena spp.)	Western Meadowlark (Sturnella neglecta), Horned Lark (Eremorphila alpestris), Calif. Ground Squirrel (Citellus beecheyi), Black-tailed Jack Rabbit (Lepus californicus), Calif. Vole (Microtus californicus), Gopher Snake (Pituophis catenifer), Field Crickett (Acheta assimilis).
V. Freshwater Marsh	Scattered areas along coast, in back of salty areas. Around springs, ponds, along sluggish streams in Santa Clara, Contra Costa, Napa, Solano Counties. Examples - Searsville Lake; Bear Creek near Point Reyes Station.	Common Tule (Scirpus acutus), Calif. Bulrush (Scirpus californicus), Common Cat-tail (Typha latifolia), sedge (Carex senta and other spp.).	Long-billed Marsh Wren (Telmatodytes palustris), Redwinged Blackbird (Agelaius phoeniceus), Yellowthroat (Geothlypis trichas), garter snakes (Thamnophis spp.), Pacific Tree Frog (Hyla regilla), predaceous diving beetles (Dytiscus spp.), a water scavenger beetle (Hydrophilus triangularis), a giant water bug (Lethocerus americanus).
VI. Oak Woodland	Inner coastal ranges from 400 to 3,000 ft.; Napa, Solano, Contra Costa, Alameda, Santa Clara Counties. Examples - rolling hills along both edges of Santa Clara Valley and along Hwy. 101 in Marin County.	At lower elevations: Valley Oak (Quercus lobata), Coast Live Oak (Q. agrifolia). At higher elevations: Blue Oak (Q. douglasi), Digger Pine (Pinus sabiniana). Throughout: Holly-leaf Cherry (Prunus ilicifolia), Calif. Coffee Berry (Rhamnus californica), Calif. Buckeye (A. californica), Poison Oak (Rhus diversiloba).	Acorn woodpecker (Melanerpes formicivorus), White-breasted Nuthatch (Sitta carolinensis), Brush Mouse (Peromyscus boylei), Calif. Ground Squirrel (Citellus beecheyi), Calif. Sister (Heterochroa california), Calif. Oak Moth (Phryganidea californica), Calif. Prionus (Prionus californicus).

E. Hydrologic Resources[1]

Major Drainage Basins and Water Courses
Central Metropolitan Planning Unit

The Central Metropolitan Planning Unit (CMPU) is divided into a number of small watersheds which are defined by the natural topographic features of the region. The drainage patterns of the unit are characterized by a series of northeast- to southwest-trending linear drainage basins which extend from the ridges of the Oakland Hills, a part of the Diablo Range, across the urbanized alluvial plain to San Francisco Bay. The water-courses which transport runoff from each watershed are typically southwesterly-flowing creeks which have eroded canyons in the hill areas and exhibit a meandering form on the flatter gradient of the alluvial plain.

Named creeks which drain these linear basins include El Cerrito, Codornices, Temescal, Glen Echo, Trestle Glen, Sausal, Peralta, Courtland, Seminary, Lion, Arroyo Viejo, Elmhurst, and Stonehurst. A number of these creeks empty into Lake Merrit, Damon Slough, or East Creek Slough which subsequently drain to San Francisco Bay via San Leandro Bay or the Oakland Estuary. Most of the land area of these watersheds is located within the political boundaries of Alameda County and the CMPU with the exception of Codornices Creek which is located on the county line and serves portions of Contra Costa County.

The lower reaches of San Leandro Creek, which drain a large portion of the Eden Planning Unit, traverse the southern section of the CMPU and eventually empty into San Leandro Bay. The island City of Alameda, partially formed from artificial bay fill, is essentially flat and contains no major natural streams. Runoff is transported to surrounding receiving waters by an urban storm drainage system consisting of canals and underground conduits.

Eden Planning Unit

The Eden Planning Unit (EPU) has varied physiographic characteristics which result in the definition of two major hydrologic units along with a number of small drainage basins. These units include the basins of San Leandro Creek, San Lorenzo Creek, Sulphur Creek, Ward Creek, and Old Alameda Creek.

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[1] Compiled by Alameda County Flood Control and Water Conservation Division, Public Works Agency.

The San Leandro Creek Basin is located east of the City of Oakland with its main axis generally in a north-south direction. The lower reach of the creek which crosses the alluvial plain flows in a westerly direction between the cities of San Leandro and Oakland for a distance of 4.5 miles and eventually drains into San Leandro Bay. Ninety percent of the forty-eight square-mile basin is located in a mountainous area of the Diablo Range upstream from Lake Chabot and Upper San Leandro Reservoir which are owned and operated by EBMUD. Elevations in the area reach 2,000 feet; and approximately forty percent of the total watershed is located in Contra Costa County. Land use in the basin ranges from undeveloped watershed lands in the mountainous area to agricultural, residential, and light industrial in the urban area on the alluvial plain.

The 45 square-mile San Lorenzo Creek Basin is located east and south of the San Leandro unit and encompasses an expansive watershed in the hills east of San Leandro and Hayward. San Lorenzo Creek, the major watercourse in the basin, originates in the upper watershed near Route 580 and traverses the alluvial bay plain through Hayward and San Lorenzo before emptying into San Francisco Bay. Important tributaries to San Lorenzo Creek are Palomares Creek which drains the canyon bounded by Sunol and Walpert Ridges, Hollis Creek, Eden Creek, Crow Canyon Creek, Cull Creek, Castro Valley Creek, and Tanglewood Creek. Maximum elevation in the hill area which comprises the largest section of the basin is approximately 1,950 feet above mean sea level. Land development in the upper watershed of the basin is limited to ranches with some residences located adjacent to roads which parallel the major tributaries. In contrast to the rural nature of the upper basin, the lower section is being intensively developed for commercial, industrial, and residential use with some remnants of agricultural operations still evident.

The smaller basins which drain the remainder of EPU encompass portions of the hill area west of Walpert Ridge and the alluvial plain. Sulphur Creek and Ward Creek basins originate at Walpert Ridge and eventually empty to San Francisco Bay. Other named watercourses which drain small linear basins generally in an east-to-west direction include the Ashland-Washington Drainage canal, Bockman Canal, Mr. Eden Creek, and the Old Alameda Creek. These basins are essentially urban in nature and serve the developing areas between the bay and the base of the hills in the cities of San Leandro and Hayward.

Washington Planning Unit

The Washington Planning Unit (WPU) in southern Alameda County is generally characterized by numerous small hydrologic units with the exception of the lower reach of Alameda Creek which drains the largest watershed in the County and traverses the WPU. Most of the natural watercourses in the WPU originate in the vicinity of the ridge of the Mission Hills in the western portion of the unit which reach an elevation of 2,517 feet above mean sea level at Mission Peak. After traveling down the western slope of the hills, the streams emerge onto the alluvial plain and eventually empty into one of the sloughs which meander among the diked salt ponds and then converge with the receiving waters of San Francisco Bay.

The Dry Creek Basin which encompasses an area of approximately ten square miles is located northeast of the Decoto District of Union City. Dry Creek conveys runoff from this basin to a confluence with Alameda Creek southwest of Decoto. Crandall Creek, which drains a basin in Fremont north of Newark, also discharges to Alameda Creek. Named creeks which drain the western slopes of the hills and the developing alluvial plain and do not discharge into Alameda Creek include Mission Creek, Canada del Aliso, Agua Caliente Creek, Agua Fria Creek, Toroges Creek, and Scott Creek. The channels which provide the main outlet to the bay for this drainage include Newark Slough, Plummer Creek, Mowry Slough, Mud Slough, and Coyote Creek.

The Alameda Creek Basin is largely composed of land located within the Livermore-Amador Planning Unit; however, Alameda Creek conveys all surface runoff from this basin through the WPU. Therefore, this major watercourse has a hydrologic significance, particularly for groundwater, which greatly exceeds the provision of local surface drainage in the WPU.

After emerging from Niles Canyon, Alameda Creek flows along a westerly course for approximately twelve miles to an outlet in San Francisco Bay near Coyote Hills. Prior to the recent completion of the Alameda Creek Federal Project by the Corps of Engineers, the creek flowed in an ill-defined channel along a tortuous course across the plain and emptied through Patterson Creek. The improved flood channel has relieved the local flood plain area from the frequent and damaging floods which plagued it in the past. This former meandering pattern and frequent flooding were important factors in the development of the waterbearing geologic formations which underlie the WPU and now comprise a most important water supply resource.

Livermore-Amador Planning Unit

The Livermore-Amador Planning Unit may be divided into two major hydrologic units or water basins which extend past the political boundaries of Alameda County. They are the Livermore Hydrologic Unit and the Sunol Hydrologic Unit. The entire area is confined within the Diablo Range and extends over 675 square miles, or 430,000 acres. All streams and creeks flow together in the Livermore Valley near Pleasanton in Arroyo de la Laguna which then flows into Alameda Creek near Sunol and out of the Planning Unit through Niles Canyon. Of the total area land which drains into the Livermore Valley, approximately thirty-five percent is in Santa Clara County in the Mount Hamilton Vicinity. Ten percent of the drainage basin lies in Contra Costa County on the southwestern slopes of Mt. Diablo. The two water basins in the LAPU (Livermore and Sunol) may also be distinguished on the basis of geology, soil infiltration characteristics, and physiography.

The geographic area comprising the Livermore Unit extends south to the highlands surrounding San Antonio Valley (T7S, R5E) in Santa Clara County. In this vicinity, the headwaters of the del Valle originate. Runoff from the surrounding hills flows northwest in the drainage and out into the Livermore Valley where it joins with the Arroyo de la Laguna near Interstate 680 and Bernal west of Pleasanton. This unit extends north to include the area of Dublin and San Ramon and the Alamo, the South San Ramon, and Tassajara Creeks which flow out of the Upper Amador Valley. The major creeks within this drainage unit are the Arroyo del Valle, Arroyo Mocho, Arroyo Seco, and the Arroyo Las Positas. Other creeks include the Altamont Creek, Cayetano, Collier, Tassajara, South San Ramon, and Alamo Creeks. All of the above flow together into the Arroyo de la Laguna which flows in a southeast direction near Interstate 680 west of Pleasanton and out of the basin north of Verona.

There are six different physiographic areas recognized in the Livermore Hydrologic Unit. Clockwise from north to west they are the Orinda upland, Dublin upland, Altamont upland, Livermore Valley, Livermore upland, and Livermore highland. These physiographic areas are based upon elevation, slope, geologic formations, and soils, and relate directly to the hydrologic significance and importance of the area.

The Orinda upland, the Dublin upland, the Altamont upland, and the Livermore upland and highland all share a common feature of containing rock formations that are essentially low or nonwater-bearing. They range in elevation generally above 1,500 feet MSL and are as high as 3,500 feet MSL south of Livermore. The upland and highland areas serve as the collection funnel for the precipitation in the foothills and mountains. The elevations of the hills in the Livermore Highlands (4,000') play a very important role in the condensation of rainfall since the moisture-laden clouds release more water as they rise and cool. Rainfall maps showing lines of mean annual precipitation (EMAP) demonstrate an increase in rainfall with elevation especially around the peaks and ridges in the watershed.

The Livermore Valley is geologically different than the surrounding uplands and highlands. It is composed of two distinct water-bearing formations that are the major reservoir for water storage. Historically, the ground water basin reservoir has provided domestic and agricultural supplies to the Valley inhabitants.

Sunol Hydrologic Unit

The Sunol Valley is located south of the Livermore Valley. The hydrologic unit encompasses the headwaters of the Alameda, Isabel, Arroyo Hondo, and Smith Creeks around Mt. Hamilton. All precipitation falling in these hills drains through the Arroyo Hondo into Calaveras Reservoir; water draining in the Alameda Creek system joins the Arroyo Hondo north of Calaveras Reservoir and flows into Sunol Valley. Within this Sunol Unit, six physiographic areas may be distinguished: Sinbad upland, Vallecitos Valley, La Costa Valley, Sunol Valley, Sunol upland, and Sunol highland.

The Sinbad upland drains southeast, entering Sunol Valley in the north end. The eastern boundary of this densely wooded ravine is Pleasanton Ridge. Surface materials are underlain by the consolidated upper Cretaceous marine formations (nonwater-bearing). Vallecitos Valley, northeast of Sunol Valley, is a small drainage (about one mile square) through which Vallecitos Creek drains. La Costa Valley is partially occupied by San Antonio Reservoir managed by San Francisco Water Department. The Reservoir covers nearly half of the original shallow alluvial valley. Surrounding both Vallecitos and La Costa Valleys is the Sunol upland composed of the water-bearing Livermore Formation. Small areas on the eastern rim of the Sunol Unit are also Sunol upland as indicated on the map.

Sunol highland borders Sunol Valley and covers the remaining southern extension of the hydrologic unit. It is composed of nonwater-bearing rocks of the Franciscan Formation. The steep mountainous region drains in a northwesterly direction, as does the Livermore Unit. Elevations reach 4,000 feet MSL on Mt. Hamilton.

The Sunol Valley is the confluence of the streams in the Sunol Unit. It is the largest valley in the Unit and is composed of a thick layer (about 160 feet) of alluvium underlain by less pervious nonwater-bearing rock. Near Sunol, Alameda Creek meets and is joined by Arroyo de la Laguna. As Alameda Creek flows out of the Sunol Unit, it must cross Sunol Dam. Sunol Dam has been constructed so that it completely blocks the flow of water out of the Livermore and Sunol Units; thus, ground water must first rise to the surface prior to leaving Sunol Unit and entering Alameda Creek as it flows through Niles Canyon.

Precipitation and Runoff Patterns

Precipitation in Alameda County is highly seasonal with almost ninety percent of the annual precipitation occurring during the six-month period of November through April. Most of the precipitation occurs as rainfall in a series of general storms which affect all portions of the County; however, variations in local physiography strongly influence the intensity and amount of precipitation. As illustrated on the accompanying isohyetol map, precipitation patterns within the County vary with elevation, proximity to major water bodies, wind direction, and the different relationships among these major climatic influences.

Mean annual precipitation (MAP) on the bay plain along the western boundary of the County increases in a southwest to northeast trend and ranges from 13 inches MAP in the Fremont area to 21 inches MAP in Berkeley. As elevations increase on the western slopes of the Diablo Range, orographic lifting occurs which results in cooling of the air, reduction in water-holding capacity, and increases in total precipitation. Maximum MAP in the Diablo uplands east of the bay plain ranges from 27 inches in the hills above Oakland to 25 inches in the Hayward hill area.

The Valpe Ridge area in the southeast portion of the County is the wettest area with approximately thirty inches MAP. The Livermore-Amador Valley has a relatively uniform pattern of rainfall which decreases from a value of 18 inches MAP immediately east of the Pleasanton Ridge to 13 inches east of Livermore. The mountainous area in the eastern section of the County is an arid region which receives as little as ten inches MAP.

Runoff in Alameda County is derived from precipitation on the various drainage basins and from imported water released into the natural watercourses. The direct relationship between precipitation and runoff results in yearly and seasonal runoff patterns which are similar to rainfall variations. Thus, under natural conditions, streams in the County exhibit highest flows during the winter storm season and are essentially dry during the summer. Imported water discharged into streams in the Livermore Valley, diversions, and water storage reservoirs have altered the natural runoff characteristics of the major watercourses in the County.

Stream flow measured at various locations in the large drainage basins indicate the magnitude of runoff and are presented in Table 1-7. The smaller basins on the Bay Plain are drained by ephemeral streams which exhibit high flows immediately following major storms and minimal or no flow during dry weather. No runoff records are available for these streams.

TABLE 1-7

RECORDED ANNUAL DISCHARGE OF VARIOUS STREAMS IN ALAMEDA COUNTY[1]

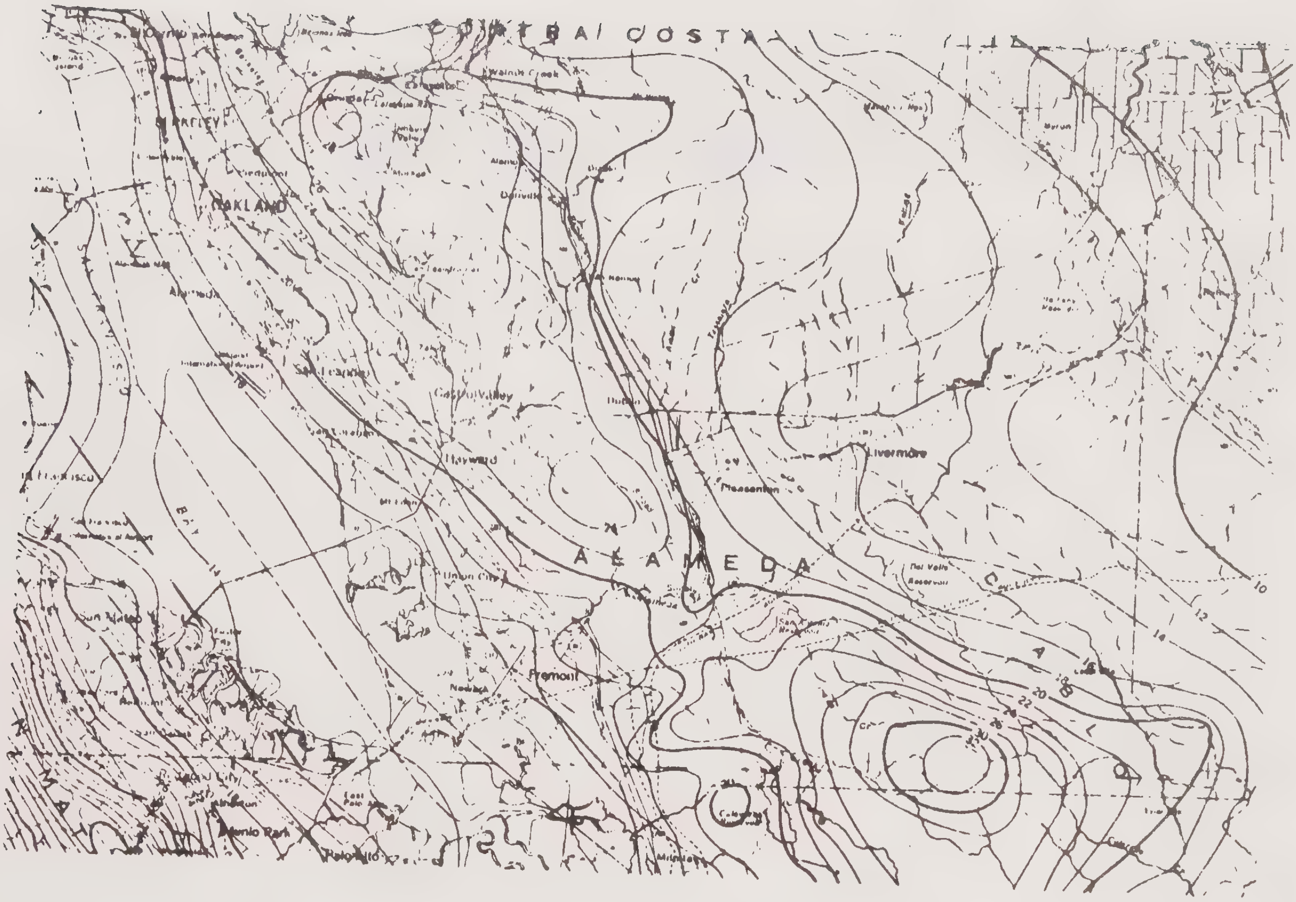
Stream	Location	Area (Miles^2)	Years of Record	Mean Annual Discharge (acre-feet)
Alameda Creek Basin				
Arroyo Mocho	Livermore	38.2	1912-1930	2,920
Arroyo Mocho	Pleasanton	141	1962-1972	9,640
Arroyo del Valle	Above Reservoir	126	1963-1972	18,760
Arroyo del Valle[2]	Livermore	147	1912-1930 1957-1968	21,450
Arroyo de la Laguna	Pleasanton	405	1912-1930	30,790
Alameda Creek[3]	Niles	633	1891-1962	89,050
Alameda Creek[3]	Niles	633	1963-1972	63,180
Dry Creek	Union City	9.41	1916-1919 1959-1972	1,170
Other Basins				
San Lorenzo Creek[4]	Hayward	37.5	1946-1972	10,140
Castro Valley Creek	Hayward	5.51	1971-1972	1,090

[1] United States Geological Survey, Water Resources Data for California, Part 1, Surface Water Records, 1972

[2] Beginning in 1968, discharges at this station were regulated by Del Valle Reservoir. Water from the South Bay Aqueduct can be pumped to the reservoir and released for downstream percolation.

[3] Flow regulated by Calaveras Reservoir beginning in 1916, San Antonio Reservoir beginning in 1965, and Del Valle Reservoir. Imported water affected flow beginning in 1962.

[4] Flow partially regulated by Cull Creek Reservoir beginning in 1962 and Don Castro Reservoir beginning in 1965.



SOURCE: Rantz, S. E., Mean Annual Precipitation and Precipitation Depth Duration-Frequency Data for the San Francisco Bay Region, California, USGS, S.F. Bay Region Environment and Resources Planning Study, Basic Data Contribution 32, 1971.

The various diversions, impoundments, exports, and imports which modify the natural runoff in the Alameda Creek Basin have a significant impact on the water supply systems of both the Livermore-Amador and Washington Planning Units. The major effects of the modifications in the natural runoff regime have been a reduction in peak storm flows and total annual discharge and a sustainment of greater than natural stream flow during the dry season. Major benefits accruing from these alterations include direct use of natural runoff for water supply through storage in, and distribution from, surface reservoirs and increases in recharge capability to groundwater aquifers.

Lakes, Reservoirs, and Other Surface Water Storage

Surface water resulting from precipitation or imports may be stored in a variety of facilities of either natural or man-made origin. Natural surface storage is accomplished by lakes, ponds, marshes, and bogs while man-made facilities include concrete and earth-fill dam-created reservoirs, enclosed steel and concrete reservoirs, and diked areas. The relative absence of any significant natural surface storage in the County and the seasonal nature of prevailing precipitation patterns have necessitated the construction of many surface storage basins in appropriate locations.

Artificial storage of surface water in Alameda County is instituted for numerous purposes and is accomplished through techniques dictated by natural physiographic characteristics and the objectives of the impoundment. Enclosed storage tanks are commonly constructed as integral parts of urban water supply systems to provide pressure regulation, meet peak demands, and provide emergency supplies. Many such tanks of varying sizes are located throughout the developed areas of the County. Unenclosed storage reservoirs range from small siltation basins and stock ponds to large multipurpose reservoirs located on major watercourses. Important characteristics of the major reservoirs in the County are presented in Table 1-8.

An extensive area of unique artificial water storage facilities is located in southwestern Alameda County in the bay tidelands region. Miles of dikes have been constructed in the area to create thousands of acres of evaporative salt ponds. Salt concentrations in bay water are increased through natural processes of evaporation until a sufficiently dense solution is obtained to precipitate salt crystals which are then harvested. In addition to their economic value, these ponds provide a valuable wildlife habitat for migratory and resident shorebirds and waterfowl.

Small stock ponds, silt basins, and stormwater retention ponds are found throughout the County. The majority of the stock ponds are located in the foothill regions to serve the extensive grassland areas utilized for grazing while silt and stormwater retention basins are becoming more prevalent in urban areas.

No major natural lakes exist in the County and few natural ponds are found. Lake Merritt (160-acre surface area), in Oakland, and Lake Elizabeth (63-acre surface area), in Fremont, are natural receiving bodies for local creeks which have been somewhat modified for flood control and recreation purposes. San Francisco Bay, although essentially an inland extension of the Pacific Ocean, may be considered a natural surface storage area along with the tidal salt marshes remaining along the interface between land and water.

TABLE 1-8.

MAJOR SURFACE RESERVOIRS IN ALAMEDA COUNTY

Name	Stream	Capacity (acre ft.)	Agency[1]	Major Purpose
Del Valle	Arroyo Del Valle	77,000	DWR	Water supply, recreation flood control
Bethany	Calif. Aqueduct	4,850	DWR	Water supply
Calaveras	Calaveras	100,000	SFWD	Water supply
San Antonio	La Costa	51,000	SFWD	Water supply
Chabot	San Leandro	10,000	EBMUD	Water supply, recreation
Upper San Leandro	San Leandro	41,000	EBMUD	Water supply
Cull	Cull	295	ACFCWCD	Recreation, water conservation
Don Castro	San Lorenzo	380	ACFCWCD	Recreation, water conservation

[1] DWR - Department of Water Resources
SFWD - San Francisco Water District
EBMUD - East Bay Municipal Utility District
ACFCWCD - Alameda County Flood Control and Water Conservation District

Groundwater Resources
Central Metropolitan Planning Unit

The Central Metropolitan Planning Unit does not contain any significant groundwater resources utilized for water supply. Although there are wells in the area which are mainly operated by industrial concerns for their various needs, total yield of groundwater is not significant. Data on groundwater in the area and the subsurface geology has not been compiled or studied in a systematic manner at this time.

Eden Planning Unit

Groundwater resources in the remainder of Alameda County have been the subject of numerous studies by various groups and agencies in recent years. The latest studies have been prepared and coordinated by the State Department of Water Resources to assist local agencies in developing efficient and productive means of groundwater management.

The Bay Plain is basically composed of an alluvial area near the highlands and marshlands adjacent to the bay. The alluvial area is composed of coalescing alluvial cones which have been deposited by streams in the area. The San Leandro Cone underlies the EPU and contains water-bearing strata at various depths and locations. Water bearing sand and gravel layers extend to a depth of approximately one thousand feet below the Bay Plain and are divided into upper and lower zones. The upper zone contains two major aquifers which are located at depths of sixty feet and two hundred fifty feet and are equivalent to the Newark and Centerville Aquifers of the Niles subarea. The lower zone occupies a depth below 400 feet and contains a much higher percentage of permeable material than the low yield upper zone. Nearly all of the high yielding wells in the area utilize the deep zone. Southward sloping groundwater contours indicate that minor amounts of groundwater in the upper zone of the San Leandro Cone may migrate in a southerly direction to the Newark Aquifer in the Niles subarea.[1] Replenishment of these aquifers is accomplished primarily through percolation from the streambeds of San Leandro and San Lorenzo Creeks.

The City of Hayward formerly maintained a 30-acre well field to supply its service area. Population growth in the city resulted in the development of a new water source, imports purchased from the San Francisco Water Department, and termination of dependence on local groundwater beginning in 1950.[2] Wells in the area are currently maintained by agricultural and industrial users, and no groundwater is being utilized for a municipal supply. In spite of the current absence of municipal use of the aquifers in the EPU, a significant and valuable groundwater resource does exist. The integrity and quality of this resource should be maintained to provide a viable alternative source to potentially meet unknown future needs.

Washington Planning Unit[3]

One major groundwater subarea of great importance to the local water supply and three subareas of lesser significance are located within the Washington Planning Unit. The Niles subarea is the major basin and includes the surficial area of the Alameda Creek alluvial fan and also extends under San Francisco Bay and the Bay Plain. The Dry Creek, Mission, and Warm Springs subareas are smaller groundwater areas in the Washington Planning Unit.

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[1] Department of Water Resources. Bulletin No. 118-1. Evaluation of Groundwater Resources, South Bay. Appendix A: Geology. 1967.

[2] Hayward Water Department. "Outline of History of Hayward Water System." 1974.

[3] Department of Water Resources. Bulletin No. 118-1. Evaluation of Groundwater Resources - South Bay, Volume I: Fremont Study Area 1968. Volume II: Additional Fremont Study Area 1973. Appendix A: Geology 1967.

Two major geologic formations, the Santa Clara Formation and Quaternary alluvium, comprise the important water-bearing deposits in the region. The Santa Clara Formation of Plio-Pleistocene age is composed of poorly sorted sandstone, siltstone, and clay with evidence of well-sorted gravel lenses in exposures of the formation in the Mission Upland. These very permeable beds could account for high well production in the Mission Upland. Quaternary alluvium of Pleistocene to Recent age is composed of unconsolidated gravel, sand, silt, and clay deposited by streams draining the upland areas. Major aquifers are formed by sand and gravel deposits with high permeability while aquicludes are formed by silt and clay layers exhibiting relatively low permeability.

The Niles subarea is the most important groundwater area in terms of production in Alameda County. The subarea is characterized by a series of flat aquifers separated by clay aquicludes. Major aquifers have been identified as the Newark Aquifer (between 60 and 140 feet below the surface), Centerville Aquifer (between 180 and 200 feet), and the Fremont Aquifer (between 300 and 390 feet). Additional highly productive deeper aquifers which are unnamed are located below the 400 foot level. The Hayward Fault creates a partial barrier to groundwater movement from east to west across the fault which is demonstrated by large variations in groundwater levels on different sides of the barrier. The area east of the fault is composed of extremely permeable material, and the absence of aquicludes makes the region a forebay for recharge of the various shallow and deep aquifers. Recharge of the groundwater basin is accomplished by percolation of precipitation, storm runoff or streamflow, imported water, and applied water and excess of subsurface inflow over outflow. The most important single recharge facility for the Niles subarea is Alameda Creek and adjacent gravel pits. Storm runoff and imported water are recharged through the permeable streambed and gravel pits in a program managed by the Alameda County Water District (ACWD). Currently, water is pumped into the pits, and dikes and Fabridams (1 complete, 1 under construction) are provided in the streambed to maximize recharge of the basin.

A serious salt water intrusion problem has developed in the basin over the past half century as a result of overpumping and breaks in the upper Newark Aquiclude. Continuous overdrafting of the basin has altered the hydraulic groundwater gradient from a bayward situation to a landward orientation. Intrusion of saline water from the bay and salt ponds is caused by breaks in the clay cap and slow percolation through the clay cap itself. Under the landward hydraulic gradient, saline water moves eastward toward the forebay where it may enter deeper aquifers. At first, only the Newark Aquifer experienced serious degradation; but as years passed, the deeper Centerville and Fremont Aquifers began to exhibit contamination and the groundwater supply was seriously threatened. In addition to the saline intrusion through breaks and slow percolation through the aquiclude, it has been shown that abondoned, unsealed, or improperly sealed wells are permitting degraded water from the upper aquifer to flow into deeper aquifers. A County ordinance controlling drilling and sealing of wells has been enacted and is being administered by ACWD in its service area, the City of Berkeley in Berkeley, and by ACFCWCD in the remainder of the County. Difficulty in locating abandoned wells makes it improbable that a complete elimination of intrusion through wells will be achieved.

Reductions in the rate of saline intrusion have recently been achieved because of the improved recharge program and use of imported water. Annual amounts of saline water intrusion at 21,000 ppm equivalent salinity have been reduced from 8,600 acre-feet in 1961-62 to 1,100 acre feet in 1968-69. At such time when zero intrusion is achieved, substantial danger to the basin will remain because of the continuing presence of saline water in the basin and the probability of future dry period being accompanied by further intrusion.

Current plans of ACWD to protect the basin from saline intrusion consist of the construction of a pumping barrier anchored to the nonwater-bearing rocks comprising the Coyote Hills to form a protective arc of wells surrounding the important production areas of the Newark Aquifer. Pumping will remove some saline water now in the aquifer while creating a gradient to prevent further inland movement of degraded water.

The Dry Creek subarea extends from the hillfront where Dry Creek emerges for a distance of three miles to the southwest. The maximum thickness of the recently deposted alluvial fan is 350 feet; and the sand and fine gravel aquifers are thin and discontinuous. Recharge occurs at the eastern edge of the subarea by percolation from Dry Creek. Water levels are usually high in the area, but well production is not particularly good in most cases.

The Mission subarea encompasses exposed portions of the Santa Clara Formation in the Mission Upland and a small alluvial area immediately east of the Hayward Fault. Maximum thickness of the formation is estimated at 500 feet with high percentages of gravel found throughout the formation.

Stratification and a 30 degree eastward dip of the formation precludes any westward flow of groundwater. A northwesterly gradient does exist from the Mission subarea to the Niles alluvium, but contributions to the alluvium are minor. Recharge occurs from percolation of streamflow and precipitation.

The Warm Springs Alluvial Apron and certain sediments farther west constitute the Warm Springs subarea. Aquifers in the basin are thin, fine-grained, and exhibit low productivity. Recharge is limited because of low permeability; and although some groundwater from the basin moves west into the Niles subarea, total contributions are negligible.

Importance of the groundwater resource underlying the WPU cannot be overemphasized. The Alameda County Water District which serves Fremont, Newark, and Union City, and Citizens Utility Company which distributes supplies to Niles and Decoto each utilize groundwater as their main water supply source. Additionally, many industrial and agricultural operations maintain private wells in the groundwater basin. Rapidly increasing demands have necessitated the development of new sources which include South Bay Aqueduct water from the State and water purchased from the San Francisco Water Department. These supplemental sources are not sufficient to meet all requirements without major use of the groundwater resources.

Currently, most groundwater production is from the forebay area east of the Hayward Fault which is uncontaminated by saline intrusions. In 1973-74, production from the eastern area was estimated to be 18,200 acre-feet compared to a western area yield of 16,200 acre-feet. By 1995, it is anticipated that the WPU will require 80,000 acre-feet of water per year of which 25,000 acre-feet will be provided by the groundwater resource.[1] In addition, the groundwater basin will serve as a storage facility for much of the 42,000 acre-feet to be imported from the State. Much of this imported water will be recharged to the basin through artificial facilities and subsequently pumped for municipal distribution. Thus, it is quite important to institute sound groundwater management practices to insure the maintenance and improvement of the quality and quantity of this resource.

Livermore-Amador Planning Unit[2]

The two major hydrologic units of the Livermore-Amador Planning Unit, Sunol Valley and Livermore Valley, may be further divided into groundwater sub-basins based on hydrologic and geologic factors. The 15 sub-basins which have been identified comprise a valuable resource which is now utilized extensively for municipal, industrial, and agricultural water supply.

The various physiographic areas of the LAPU contain both nonwater-bearing and water-bearing geologic formations. Nonwater-bearing formations are exposed in the Diablo Range and are located at depths of 1,000 feet below the Livermore Valley and several hundered feet below the Sunol Valley. Water-bearing materials are found on the valley floor in Livermore, Sunol, LaCosta, and Vallecitos Valleys and in adjacent uplands to the south, west, and north of the Livermore Valley. The three significant water-bearing formations in order of importance are the alluvial valley fill, the Livermore Formation, and the Tassajara Formation.

The Tassajara Formation is located north of the Livermore Valley and beneath the central portions of the valley at depths ranging from 200 to 750 feet. The water-bearing sandstone in the formation has a relatively low permeability and yields low quantities of moderately good quality waters suitable for limited stock, domestic, and irrigation use. There are no significant hydrologic connections between the Tassajara Formation and overlying materials.

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[1]City of Fremont, Conservation Element of the General Plan, 1973.

[2]Department of Water Resources. Bulletin No. 118-2. <u>Evaluation of Groundwater Resources: Livermore and Sunol Valleys</u>. 1974.

The geologically younger Livermore Formation occurs beneath the floors of the Livermore and Sunol Valleys at depths ranging from 30 to 400 feet and is exposed on the south and east side of the Livermore Valley and on the east side of Sunol Valley. The clayey gravel aquifers in the formation yield significant quantities of good quality water in the eastern section of the Livermore Valley for municipal, industrial, and agricultural users.

The Valley fill alluvial materials which overly the Tassajara and Livermore Formations are composed of Holocene Age unconsolidated gravel, sand, silt, and clay that range in thickness from a few feet to almost 400 feet. The upper aquifer in the alluvium is unconfined while lower aquifers are leaky or semi-confined. Wells in this formation produce groundwater of a generally good quality suitable for high capacity uses.

Increasing intensity of groundwater use over the past century in the LAPU resulted in an excess of removal over recharge which produced reductions in groundwater levels. During the late 1950's and early 1960's, groundwater levels in the central Livermore Valley were lowered from an average elevation of 250 feet to 280 feet. Lower water levels and water reuse also caused degradation of water quality in some sub-basins. Recent implementation of improved groundwater recharge management practices has reversed the quantitative imbalance and will restore supplies if continued.

The major groundwater reservoirs in LAPU are located in the central and western portions of the Livermore Valley and include the Bernal, Amador, and Mocho sub-basins. Over one hundred wells are operated in this region to provide large quantities of water for major users in the basin. Yield from sub-basins in the Sunol Valley is generally low because of availability of SFWD water, a small producing area, thin alluvium, and confining space of small valleys. Other than the Sunol Filter Galleries which collect sub-basin groundwater to augment SFWD supplies, extraction from wells is negligible.

Variations in the mineral content of groundwater in different sub-basins and movement of groundwater between basins are important in analyzing the quality of the water supply source. Horizontal movement of groundwater is controlled by fault locations, variations in aquifer thickness, and different permeability of aquifer materials while verticle movement is determined by hydraulic continuity between water-bearing formations and internal stratification. Groundwater movement in the Livermore Valley generally occurs downslope toward the longitudinal axis of the valley and then in a westerly direction to the Bernal sub-basin. Because of withdrawals from deep wells in the Bernal sub-basin, subsurface outflow to the Sunol basin does not occur.

While the mineral quality of groundwater in the Livermore and Sunol Valleys is generally adequate for most beneficial uses, there are exceptions in some areas. Groundwater quality is usually dependent upon the source of replenishment and character of subsurface sediments. The central and southern portions of the Livermore Valley are recharged from streamflow of the Arroyo Mocho and Arroyo Del Valle which exhibit good quality magnesium bicarbonate and calcium bicarbonate waters. The eastern area of the Livermore Valley contains some groundwater of poor quality sodium chloride character. The major source of this mineral is recharge from Altamont Creek. Another area of poor quality sodium chloride and sodium

sulfate water occurs southeast of Dublin. Excessive concentrations of nitrate, boron, and total dissolved solids are found in various sites throughout the Livermore Valley and frequently are high enough to render groundwater undesirable for domestic or industrial use. Groundwater quality in the Sunol Valley is usually adequate for irrigation purposes although some excessive nitrate concentrations (greater than 44 ppm) are evident in some shallow wells.

Recharge of the groundwater basin is accomplished by infiltration and percolation of precipitation, streamflow, and applied water. Subsurface inflow provides a limited source of replenishment where wells penetrate both the alluvium and the underlying Tassajara and Livermore Formations and where stream channels intercept the Livermore Formation.

A balance of recharge with consumption must be achieved to maintain the productivity and quality of the groundwater resource. This has recently been accomplished in LAPU under the overall management of Zone 7 of the Alameda County Flood Control and Water Conservation District with cooperation from the four water retailers in the area (City of Pleasanton, Valley Community Services District, City of Livermore, and California Water Service Company). The imposition of independent pumping quotas on municipal users of groundwater, the availability of imported waters through the South Bay Aqueduct and Del Valle Reservoir of the State Water Project, and the use of artificial recharge have all contributed to the restoration of a positive balance in the groundwater basin.

Groundwater pumpage in the Livermore Valley averaged 23,900 acre-feet annually from 1961 to 1970 with municipal and industrial users averaging 11,450 acre-feet and irrigated agriculture 12,450 acre-feet. As agricultural land use diminishes in response to expanding urban development, it can be expected that agricultural pumpage will decrease. Increases in urban demand will largely be accommodated through direct use of imported water following treatment.

Water Quality Management Conditions

The management of water quality in Alameda County is a complex problem which must be approached with an understanding of the systematic nature of the hydrologic cycle. It is only possible to achieve desired water quality through a program which acknowledges the interactions involved and implements procedures to manage the resource on a regional basis. Toward this end, the San Francisco Bay Regional Water Quality Control Board was established to formulate water quality objectives and policies and to enforce specific regulations and requirements. The Bay Area Sewage Service Agency was subsequently created to deal with the specific problems of wastewater treatment and disposal.

Numerous other agencies in Alameda County have concerns for water quality on both a comprehensive and local level depending on their jurisdiction and purpose. Alameda County Flood Control and Water Conservation District is the only existing county-wide agency with concerns for the quality of both surface and groundwater resources. Of course, all of the water supply agencies and State and County Public Health Departments are concerned with the quality of sources and various cities and agencies involved in the provision of aquatic recreation are cognizant of the situation as it affects their facilities. Governmental agencies assigned to protect fish and wildlife resources are also constantly alert to alterations in water quality which could affect aquatic ecosystems.

Water quality problems in Alameda County may be divided into three interdependent categories: bay water, land based surface water, and groundwater. Desirable levels of water quality are based primarily on the current use of the water but also must consider man's potential needs and technological abilities. Once standards are established, a difficult task which is constantly being modified by new information, and it is established that a problem does exist it is necessary to identify sources and implement programs to eliminate or mitigate the source. The key primary carriers of pollutants are surface creeks and lakes which replenish groundwater basins and subsequently discharge to the bay.

Current major sources of pollutants include wastewater treatment plants, direct sewage discharges, urban runoff, irrigation waters, industrial effluent, accidental oil and chemical spills, and dredging. Water quality problems resulting from these sources include dissolved oxygen depletion, health hazards from high bacteriological concentrations, biostimulation, toxicity, pesticide accumulation, and excess floatable hydrocarbons.

The major water quality problem on the heavily populated Bay Plain of Alameda County is the discharge of effluent from wastewater treatment plants to the bay. This is a two-part problem which includes the level of treatment of wastewater and the location of outfalls. In order to achieve desired protection and enhancement of bay waters and meet long range and immediate state and federal water quality objectives and requirements, it is necessary to upgrade treatment of wastewater to a "secondary" level and limit discharges of effluent to the central bay where adequate flushing action is available. Programs are now being planned by Special District No. 1 of EBMUD and the East Bay Dischargers (a joint group of wastewater collection and treatment agencies including the City of Hayward, Oro Loma Sanitary District, Castro Valley Sanitary District, City of San Leandro, and Union Sanitary District) which will provide a secondary level of treatment and an interceptor sewer to transport treated effluent to an outfall in the central bay.[1]

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[1] Jenks and Adamson/Kennedy Engineers. East Bay Dischargers Water Quality Management Program. 1972.

A significant water quality problem which is beginning to be recognized in urban areas is the high pollutant load contributed by urban storm run-off. Pollutants from an urban environment range from nutrient chemicals and pesticides of floatable hydrocarbons and oxygen demanding organic matter. The quantities of pollutants involved probably far exceed point source contributions such as wastewater treatment plants and industrial dischargers. The difficulties and cost involved in controlling such a complex source are immense; but, nonetheless, improvement programs may be attempted in future years.

Quality of the EBMUD water supply sources and the City of Hayward sources are dependent upon conditions in the watersheds from where their supply is imported. Quality of the groundwater source managed by ACWD in the Washington Planning Unit was discussed earlier to some extent with regard to saltwater intrusion. However, another important factor affecting groundwater quality in the Washington Planning Unit is the quality of replenishment waters. While much of the recharge in WPU is from local precipitation and runoff and imported sources, a significant portion is generated from the Alameda Creek basin located largely in LAPU. Thus, the quality of surface runoff in this basin is important to the water resource in the Niles Cone as well as the groundwater reservoirs in the Livermore Valley.

The quality of surface runoff from the Alameda Creek Basin is generally good except during periods of low flow when natural or imported water runoff is insufficient to dilute wastewater discharges from treatment plants in the valley. The City of Livermore wastewater treatment plant and the Valley Community Services District plant discharge significant amounts of effluent to Arroyo Las Positas and the Alamo Canal, respectively, which have the potential to degrade surface water in downstream areas and groundwater basins in both the Livermore-Amador and Washington Planning Units. Additional treated effluent is disposed by irrigation of rangeland with effluent and evaporation from ponds. The high salt content of the effluent is the most significant problem as it probably contributes to excessive mineral concentrations in groundwater.

The Livermore-Amador Valley Water Management Agency (LAVWMA) is currently considering alternative plans for wastewater management in LAPU. Alternatives suggested in the "Water Quality Management Plan for the Alameda Creek Watershed Above Niles" by Brown and Caldwell include transport of treated effluent from valley by pipeline, demineralization of effluent and/or the water supply, dilution with imported water, and reclamation of treated wastewater. The recommended plan involves the conveyance of treated wastewater to a storage reservoir in Doolan Canyon where it would be released in a stream during wet weather and disposed on land during dry seasons.

The Army Corps of Engineers, in coordination with the County Public Works Department, is presently studying the flood plain problems of Alameda Creek and its tributaries.

Infiltration and runoff of unconsumed agricultural irrigation waters are problems which occur wherever agricultural land use is prevalent. High nutrient and salt loads from fertilizers and concentrations of pesticides are common constituents of such waters. This source of degradation is particularly significant in the Livermore Valley where a closed groundwater basin and adverse salt balance already exist. Other liquid and solid waste materials which can contribute to degradation include septic tanks, cesspools, and authorized or unauthorized land disposal of solid waste.

F. Mineral Resources

Alameda County is located within the Coast Ranges, a system of northwest-trending longitudinal mountain ranges and valleys which are comprised of Mesozoic and Cenzoic rocks controlled by faulting and folding.[1] Found extensively in the Coast Ranges, the Franciscan Formation is prominent in the southeastern part of the County. The Franciscan Formation is an assemblage of Upper Jurassic to Upper Cretaceous rocks consisting of sandstone and a variety of rock types such as graywacke, dark shale, limestone, chert, basalt, diabase, ultra-basics, serpentine, and schist.[2] Adjoining the Franciscan rocks are marine sedimentary rocks of lower Cretaceous to mid-Tertiary ages. These rocks consist primarily of sandstone and shale with some conglomerate. Deposits of Plio-Pleistocene and Recent age are also prevalent in the County. These deposits of soil, gravel, and sand are located along the coastal plain and valleys, especially in the Livermore Valley area.[3,4]

Alameda County contains a variety of minerals both metallic and non-metallic. Major mineral resources are: sand and gravel, salt, stone, petroleum, and clays. The following minerals are present in the County, and extraction has been reported: asbestos, bromine, chromite, coal, copper, gold, lead, lime, magnesite, magnesium compounds, manganese, potash (potassium salts), pyrite, silica (molding or specialty sand), silver, soapstone, and travertine.[5]

Prior to 1857, coal was discovered at Tesla in Corral Hollow in the eastern part of the County. From 1897 to 1902, sub-bituminous coal was extracted from steeply-dipping Eocene beds at the rate of more than 70,000 tons per year. In all, 350,000 tons were mined; and no production has been reported since 1904.[6]

Two mines yielded pyrite ore, the Alma mine (1891-1921) and the Leona mine (1895-1934). The ore contained sulfur, iron, copper, gold, silica, and silver. During the period 1929 to 1935, more than 375,000 pounds of copper valued at more than $53,000 was leached out of the pyrite ore. In addition to being present in pyrite ore from Leona Heights, gold was also found in some of the quartz stringers in the shales and schists of the west flank of the Berkeley Hills and the slopes north of Berkeley.[7]

Small deposits of several minerals were exploited in the early 1900's. A small tonnage of short-fiber asbestos was produced in 1915 and 1918. The southeastern part of the County near Cedar Mountain produced chromite in small quantities, and no production has been reported since 1904. Present as coarse crystalline galena in 100-pound lumps, lead production in 1902 was 1,500 pounds. Hydrous magnesium silicate, commonly called talc, soapstone, or steatite, has been produced in Alameda County. Soapstone is the impure, massive variety of the mineral, containing as little as 50 percent talc. Production of soapstone occurred in 1908 and 1910.[8]

Salt-plant bitterns are no longer being used as a source material for bromine, magnesite, artificial or synthetic gypsum, magnesium compounds, and potash (potassium salts). Bromine was produced until recently when the FMC Corporation discontinued its processing of bittern in Alameda County. Magnesium compounds once formed an important part of the County's total mineral production. Magnesite[9] was also obtained from pockets and veins associated with a body of serpentine at Cedar Mountain and on Rocky Ridge, but there has been no production since 1917.

From 1894 to 1922, manganese was produced intermittently with the largest annual production in 1918. There was no production from 1923 to 1941, but 310 long tons valued at $11,296 were produced during 1942-1945. Manganese ore occurs in chert of the Franciscan Formation in approximately 30 localities in Alameda County in the Arroyo Mocho Valley area and Altamont Pass.[10] The Ladd mine in eastern Alameda County is the largest in the state.[11]

Natural minerals called "ochers" have been used as paint pigments. These natural pigments have gradually been replaced by synthetic ones, and production of natural pigments in Alameda County has not occurred in more than a year.

Oyster shell deposits of Late Quaternary age are a raw material of high lime content. Shells were once calcined to produce lime and have been used in the manufacture of cement. Crushed shell has been used as poultry grit and for soil conditioning. Between 1924 and 1969, 30,000,000 tons of oyster shells were dredged from the San Francisco Bay. Most of this dredging occurred in the vicinity of the San Mateo Bridge, east of the main ship channel. Dredging also occurred south of the Dumbarton Bridge.[13,14]

Salt

The salt industry of Alameda County is centered at Newark and is based on the age-old method of solar evaporation which has been perfected and modernized. Three environmental factors have contributed to the success of this method. The lack of rain during the summer months and the summer winds cause high evaporation. The many acres of salt marsh provide low-lying land on which the necessarily large acreage of evaporating ponds may be constructed. These salt marshes are at or close to sea level, thereby minimizing pumping; and the clay soil minimizes leakage. Also, Bay Area industries provide a ready market.[15,16]

Sea water yields common salt, magnesium compounds, artificial gypsum, bromine, and potassium salts. Sea water averages 3.45 percent salts. Bay water averages only 2.8 percent salts, as it has been diluted with fresh water.[17] The difficulty in salt recovery is to extract sodium chloride (NaCl) with minimal contamination from other salts which affect taste and deliquescence. These bittern salts became important during World War I when a shortage of chemicals created new interest in bittern, the waste product of salt recovery. The salt companies have not been involved in the recovery of bittern salts since 1926.[18] Synthetic gypsum, magnesium compounds, potassium salts, and bromine are no longer being produced from bittern in Alameda County.

SAND AND GRAVEL DEPOSITS, ALAMEDA COUNTY
QUARRY PERMITS, ALAMEDA COUNTY PLANNING DEPARTMENT

NAME - LOCATION	TYPE	ROCK TYPES, SOURCE	GENERAL FEATURES	OPERATOR
ALAMEDA CREEK Niles-Centerville Area	Shallow alluival cone deposits of ancestral Alameda Creek	Graywacke, vein quartz, chert, siltstone, greenstone, schist, granitic rock derived from So. Coast Ranges	Overburden ranges from 3-40' thick. No replenishment of deposit. Sub-angular to sub-rounded gravel, most less than 4". Deposit slightly deficient in fine sand.	Kaiser Sand & Gravel, Oak. Niles Sand & Gravel, Niles Pacific Cement & Agg., S.F. Rhodes & Jamieson, Ltd.,Oak
ARROYO DEL VALLE; ARROYO DEL MOCHO Livermore-Pleasanton Area	Present stream channels and ancestral alluvial fan deposits	Graywacke, vein quartz, chert, siltstone, greenstone serpentine, schist derived from Southern Coast Ranges	Overburden ranges from 0' in streambed to 35' in the fan. Gravel size from 6 to 10"; No replenishment on fan; replenishment in stream beds. Sub-angular to sub-rounded gravel.	California Rock & Gravel, S.F. Consumers Rock & Cement Co. Continental Land Co., Inc. Deetz Sand & Gravel, Pleas. Kaiser Sand and Gravel Niles Sand & Gravel, Niles Oliver de Silva Co. Pacific Cem. & Aggregates Rhodes-Jamieson, Lts.,Oak.
CALAVERAS CREEK near Sunol	Streambed and adjacent flood plain deposits	Metagraywacke, chert, schist from Southern Coast Ranges	No overburden in stream bed to a few feet on flood plain. No replenishment. Maximum size usually 8". Some clay in the fine fraction	Concrete Service Co, San Jose Santa Clara Sand & Gravel

Sources: Mineral Resources of California, 1966
Sand and Gravel in Central California, 1964

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The extraction of sodium chloride may involve as many as ten concentrating ponds. The brine in the last pond is approximately 21.5 percent salts and has taken four to five years to reach this concentration. After the winter rains, the brine flows into crystallizing ponds; and the bittern is drained off. Four to six inches of salt forms during the evaporation season. Crude salt, which is 99.50 percent sodium chloride, is harvested from September to late December.[19]

Salt is a low-priced commodity; overland bulk shipment contributes heavily to its cost. Therefore, processing plants are located close to the producing ponds. The Oliver Brothers Salt Company produces crude industrial salt from approximately 200 acres of ponds. Production varies due to environmental factors but averages 10,000 tons per year. The Oliver Brothers Salt Company is not engaged in refining. The Morton Salt Company does not recover salt from bay water. It refines and processes the crude salt obtained from the other companies. The Leslie Salt Company is the largest producer in the Bay Area and is also involved in refining. Its recovery and processing operations cover approximately 25,740 acres in the south bay and more than 22,000 acres in Alameda County. Salt ponds cover about 20,500 of these acres. Leslie Salt Company averages 560,000 tons per year from its Alameda County operations. It produces all grades including table salt and pressed blocks.[20]

One of man's most important commodities, salt has many uses. In industry, it is utilized as a refrigeration agent, as a chemical in manufacturing, as a raw material for the manufacture of chemical products, and as a preservative and seasoning for food. The agricultural, metallurgical, and ceramic industries use salt. For medicine, salt in solution and as a solid is applied externally and internally. Historically, salt has been used as a preservative and a dietary element for centuries. Some cultures have attributed religious significance to it, and others have used salt as a form of currency.[21]

Salt production is a principal industry in Alameda County. The contiguity of the salt ponds to the largest processing plant at Newark insures their existence in the foreseeable future. In 1972, the Congress approved a 21,662-acre National Wildlife Refuge in the South San Francisco Bay Area. Included in the Refuge are 12,243 acres of Leslie Salt Company property, most of which is now used for salt recovery. The company has been assured that continued salt production is considered compatible with the Refuge. The Refuge is not expected to impede salt harvesting operations in that area.[22]

Stone

"Stone" may be defined as material which has been broken or quarried from larger masses of rock. It is obtained from the ordinary rocks that make up the earth's crust. As the use of dimension stone has declined and dwindled, the production of crushed and broken stone has increased. The industry defines crushed and broken stone as all stone in which the shape is not specified, such as material used as aggregate, railroad ballast, and riprap.[23]

Production of stone has varied in the last decade from 1,461,000 short tons in 1963 to 2,924,000 short tons in 1965. Production in 1971 totaled 1,871,000 short tons.

Five quarries in Alameda County are producing crushed and broken rock. The Dumbarton Quarry at Newark mines redrock, a term for the volcanics and ferruginous chert and shale of the Franciscan Formation; redrock is used for road base and for general purpose fill.[24] The San Leandro Rock Company's quarry on Lake Chabot Road produces redrock and decomposed granite. Decomposed granite is a mass of quartz grains, clay, and partially decomposed grains of feldspar and ferro-magnesian minerals and is used in relatively non-exacting uses.[25]

Conglomerate is a miscellaneous stone material. Composed of classic sedimentary rock which contains hard, well-rounded pebbles of chert and volcanic rock in a matrix of sand and finer-grained material, conglomerate is widespread in small lenses in the Franciscan Formation. It is an excellent material for road base and general fill purposes.[26] The La Vista Quarry in Hayward mines conglomerate as does Oliver De Silva, Inc. in the Dublin area.

The Leona Quarry in Leona Heights produces a material which is as hard as granite[1], called rhyolite or "blue rock." Leona Rhyolite is a volcanic rock of Tertiary Age found on the crest of the Berkeley Hills. It is of high strength and is a major source of fill and base rock.[27]

Petroleum

The commercial production of petroleum in Alameda County is a recent event when it is compared with the long history of the salt, sand and gravel, stone, and clay industries. Yet, in 1970, petroleum ranked as the fourth most valuable mineral produced in the County, ahead of clays. And, there was an average of 6 producing oil wells.[28] At present, 7 wells are producing high-grade crude at the rate of 275 barrels per day.[29]

Clays

Clay is a natural, earthy, fine-grained material which develops plasticity when a limited amount of water is mixed with it, a reversible process. When subjected to prolonged and intense heating, clay becomes hard and immune to moisture.[30]

The recovery of useful clays in Alameda County began at Corral Hollow and was incidental to early local mining operations. High-grade fire clays became the basis for a successful clay industry from 1897 to 1912. Large-scale open pit mining was not possible at Tesla due to the steeply dipping beds. Though the clay was of excellent quality, mining was discontinued because of the high costs associated with underground mining.[31]

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[1] Representative of Gallagher and Burk, Inc.

Fire clay is composed primarily of kaolinite-group minerals. Its most important characteristic is refractoriness, a high resistance to heat. This type of clay is used in ceramic products including common brick, art pottery, sewer pipe, and ornamental tile.[32]

Miscellaneous or common clay deposits are comprised of low-grade alluvial clays, shales, soil materials, and less pure clays of any other clay groups. Common clays are used in the manufacture of heavy clay products such as building brick, structural tile, and sewer pipe. Often miscellaneous clay is blended with other types to make higher-grade ceramic products. Large quantities are also used in making portland cement and in the manufacture of expanded shale light-weight aggregate.[33]

Deposits of common clay suitable for the manufacture of brick, sewer pipe, and roofing tile are located in the Livermore Valley and on the Niles alluvial cone.[34] The clay has been mined by surface methods. Shale material in the Fremont-Sunol area is of high quality due to its consistency, lightness, strength, and high degree of utility. These expansible shales are processed in rotary kilns by intense thermal treatment in order to produce light-weight aggregate.[35] Average annual production of shale is presently 200,000 tons per year.[36]

Sand and Gravel

Alameda County is a principal source of aggregate materials for the San Francisco Bay Area. Much of the sand and gravel used in the Bay Area is obtained from open pit mines in deposits near Fremont and Pleasanton.[37] Sand and gravel is the County's most valuable mineral resource.

Sand is defined commercially as a term applying to rock or mineral fragments which range in size from .003 of an inch to .25 of an inch. Gravel consists of rock and mineral fragments ranging in size from more than .25 of an inch to a maximum of 3.5 inches. Sand and gravel are natural detrital stone materials which usually require only sizing and washing before marketing. Aggregate material is comprised of crushed stone, sand, or gravel used in such materials as concrete, macadam, plaster, terrazzo, road metal, and railroad ballast. This inert, fragmental material is bound into a conglomerate mass by cementing materials. Special sands are high-quality silica sands.[38,39]

Sand and gravel are low-priced commodites which cannot be transported any great distances due to high costs of trucking. In 1969, the maximum truck haul which was economically feasible was 43 miles, when the closest source was depleted; and the average maximum haul was 30 miles. Therefore, the principal markets are the large population centers close to the deposits.[40]

According to Harold B. Goldman of the California Division of Mines and Geology, the pit sand deposits will most probably be exhausted before bay sources are able to be exploited economically. Deposits west and south of Alameda Naval Air Station are estimated by the Army Corps of Engineers to contain 10,000,000 cubic yards of sand for hydraulic fill, and deposits west of Bay Farm Island contain 60,000,000 cubic yards of sand.[41]

At present there are no operations in the Tesla Formation deposit in eastern Alameda County. These Eocene or early Tertiary deposits contained specialty sands and were a source of supply for the foundry industry. Obtained from sedimentary sandstone formations at the old Tesla coal mine, the foundry sand contained 70 to 95 percent quartz sand and 5 to 30 percent feldspar. The Tesla Formation deposit was the only example of underground mining of aggregate material in the County.[42,43]

Most of Alameda County's sand and gravel production is obtained from stream channel and alluvial fan deposits. The material in stream deposits is very suitable for aggregate due to the water's abrasive action during stream transport. Soft materials are ground up; the concentrated firmer particles are rounded. Rounded particles are desirable because they give a more workable mix with less cement and care than concrete made with angular materials. An alluvial fan deposit is composed of loose rock materials put down by a stream which flows from the mountains and enters an adjacent valley or plain. The abrupt change in gradient causes the bulk of the stream load to be deposited in a crudely stratified mass. Such deposits contain lenticular beds of poorly sorted sand and gravel interbedded with silt and clay. Desirable deposits are those which are free from thick clay lenses.[44,45]

The primary deposits in Alameda County are: Alameda Creek in the Niles-Centerville area; Arroyo Del Valle, Arroyo Del Mocho in the Livermore-Pleasanton area; and Calaveras Creek near Sunol.[46] In 1970, there were 15 mines operating, and total production was 9,427,000 short tons. This production increased to 10,477,000 short tons in 1971.

Mineral Resources - Footnotes

1. California Division of Mines and Geology, Bulletin 191, p. 35.

2. California State Department of Public Works, Geology - Appendix H, p. 16.

3. Goldman, Sand and Gravel in California, Part B - Central California, pp. 9, 10.

4. Davis, "Mines and Mineral Resources of Alameda County," pp. 280.

5. Ibid., pp. 280, 284.

6. Ibid., pp. 295, 296, Table 4.

7. Ibid., pp. 296, 297.

8. Ibid., pp. 285, 287, 298, 338.

9. Ibid., p. 299.

10. Ibid., pp. 301, 302.

11. Taliaferro, "Geology of the San Francisco Bay Counties," Bulletin 154, p. 123.

12. Bowen, Rocks and Minerals of the San Francisco Bay Region, p. 22.

13. Goldman, "Salt, Sand, and Shells: Mineral Resources of the San Francisco Bay," pp. 35-38.

14. Bowen, Op. Cit., p. 60.

15. Goldman, Op. Cit., "Salt, Sand, and Shells: Mineral Resources of the San Francisco Bay." p. 39.

16. Ver Planck, "Salines in the Bay Area," Bulletin 154, p. 219.

17. Goldman, Op. Cit., p. 38.

18. Ver Planck, Op. Cit., pp. 221-222.

19. Goldman, Op. Cit., p. 39.

20. Information was obtained from company spokesmen during November, 1973.

21. Davis, Op. Cit., p. 314.

22. Goldman, Op. Cit., p. 40.

23. California Division of Mines and Geology, Bulletin 191, pp. 392, 393.

24. ABAG, Regional Geology, p. 12.

25. California Division of Mines and Geology, Op. Cit., p. 39.

26. California Division of Mines and Geology, Op. Cit., p. 398.

27. ABAG, Op. Cit., pp. 19-20.

28. Mitko and Stock, "The Mineral Industry of California".

29. Alameda County Zoning Administrator

30. California Division of Mines and Geology, Op. Cit., p. 126.

31. Ibid., pp. 129, 131.

32. Ibid., p. 127.

33. Ibid., p. 128.

34. Turner, "Clay and the Ceramic Industry of the San Francisco Bay Counties," Bulletin 154, p. 252.

35. Alameda County Planning Department, Quarry Permit #46.

36. Mr. Jerry Clewball, Kaiser Sand and Gravel Company.

37. Goldman, Op. Cit., p. 40.

38. Turner, "The Building Stone and Aggregate Industry of the San Francisco Bay Counties," Bulletin 154, p. 235.

39. California Division of Mines and Geology, Op. Cit., pp. 361, 362.

40. Goldman, Op. Cit., pp. 34, 35.

41. Loc. Cit.

42. Turner, Op. Cit., p. 238.

43. California Division of Mines and Geology, Op. Cit., pp. 371, 372.

44. Goldman, Sand and Gravel in California, Part B - Central California, pp. 7-10.

45. California Division of Mines and Geology, Op. Cit., pp. 362-367.

46. Goldman, Op. Cit., pp. 16, 20, 25.

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III. GOALS AND OBJECTIVES FOR CONSERVATION OF RESOURCES

A. Water Resources

Goal: To insure and maintain a continuing supply of high water quality for the citizens of Alameda County.

Objectives:

1. To insure sufficient water supplies of high quality for all beneficial uses.

2. To conserve ground water resources and prevent overdraft of existing ground water supplies.

3. To define areas of periodic flooding and reduce loss through the application of sound land use planning.

4. To reduce man-caused stream and ground water pollution and general resource degeneration through cumulative impacts on surface and ground water systems.

5. To maintain all water resources in their highest quality.

6. To educate government, business and citizens to assist in the conservation of water and energy and to minimize pollution.

7. Through sound design of drainage systems throughout the County and by regulation of land use, erosion of soil caused by water could be controlled.

8. To achieve coordination of state, regional and local water management agencies and policies throughout the County.

B. Vegetative and Wildlife Resources

Goal: To protect and enhance wildlife habitats and natural vegetation areas in Alameda County.

Objectives:

1. To identify areas of critical or sensitive concern for wildlife and vegetation.

2. To maintain and, if necessary, restore deteriorating environments to a level of diversity appropriate in this area of California.

3. To identify the principles of resource management as criteria for resource evaluation.

4. To educate government, business and citizens to conserve and protect wildlife resources.

C. Minerals, Extractive Resources

Goal: To insure extraction of minerals and reclamation of land to the fullest extent possible consistent with sound management policies.

Objectives:

1. To provide access to minerals through identification of the resource.

2. To permit extraction only when not detrimental to other valuable resources.

3. To utilize lower quality sources by methods which minimize environmental costs.

4. To increase recycling of mineral commodities such as metals.

5. To work with government and the extractive industries to improve mineral extraction policies and practices.

D. Agriculture and Soils Resources Management

Goal: To protect and maintain soils in Alameda County in such a manner to be beneficial to agricultural and open uses.

Objectives:

1. To conserve soil resources for agricultural productivity.

2. To preserve in agricultural use those areas of prime agricultural lands capable of producing a wide variety of valuable crops.

3. To guide urban development towards less productive land.

4. To join with the U.S.D.A. Soil Conservation Service and Agricultural Agencies in developing rational criteria for resource management and land development.

Goal: To protect and maintain the soil resources in Alameda County in such a manner as to be beneficial to all land users.

Objectives:

1. To set up rational land use and development guidelines to protect soil resources.

2. To set up rational land use and development guidelines to protect the soil resources in agricultural areas.

3. To set up rational guidelines to control non-point source pollution.

Goal: To protect agriculture and agricultural lands.

Objectives:

1. To preserve agricultural lands.

2. To promote sound land use management on agricultural lands.

3. To identify lands with little or no agricultural value for urban development provided that they otherwise meet urban development criteria.

4. To support a concept of multiple use of agricultural and grazing lands as a means of preserving economic and environmental values of the land.

E. Other Natural Resources

Goal:
- To insure and maintain the highest possible air quality in the County.
- To insure measures which conserve energy.

Objectives:

1. In areas of critical air pollution to attempt to restore and prevent further degradation of air quality.

2. To achieve coordination of air quality policies and regulations at the federal, state, regional and local level.

3. To educate government, business and citizens to assist in reducing poor air quality through alternate means of travel or by reduced use of internal combustion engines.

4. To investigate and implement measures to conserve energy.

IV. IMPLEMENTATION PROGRAM

A. Maintain data files and continue to update plan element resource information on a County-wide basis in coordination with cities.

Implementation:

- Resource mapping program
- City/County coordination
- Environmental data center
- Computer mapping program

B. Assessment of the degree of utilization and potential of resources.

Implementation:

- Renewable and non-renewable natural resources
- Areas of critical concern
- Land use studies
- Open space element implementation
- Zoning Ordinance

C. Protection of areas of critical concern.

Implementation:

- Specific plans for areas of environmental significance
- Flood plain zoning
- Subdivision Ordinance

D. In coordination with the General Plan and Open Space Element guide and control resource development and utilization through revision of legislative standards.

E. Establish zoning that reflects relationship to conservation and resource management principles.

F. Preservation of Agricultural Lands

Implementation:

- Describe and identify agricultural lands (prime agricultural land, special purpose agricultural land, prime rangeland, lands with agricultural as the highest use.)
- Maintain the Williamson Act for property owners who wish to stay in agricultural preserves.
- Modify tax structure on agricultural lands. Tax on land's capability to produce, and make agricultural lands in Alameda County competitive with agricultural lands in other counties of California.
- Develop a system of compensation to agricultural producers in those agricultural lands in close proximity to urbanization designated by the County to be maintained in agricultural production.

- Set up an agricultural advisory committee composed of farmers and ranchers, representatives of conservation agencies, and planners to develop recommended land use and development guidelines.
- Set up subcommittee to the agricultural advisory committee to develop recommended guidelines, to make recommendations on multiple uses appropriate to agricultural lands; to make recommendations regarding agricultural land preservation, and to provide readily available information on sound land use management.
- Use the United States Department of Agricultural, Soil Conservation Service Soil Survey of Alameda County to identify lands with little or no agricultural value. The agricultural advisory committee would develop criteria (for determining agricultural value).
- Alameda County, working with the Association of Bay Area Governments under the Environmental Management Program (208 Study) will establish guidance and provide implementation measures for non-point source pollution.

G. Citizen Education and Participation in Conservation of Resources.

Implementation:

- Set up educational forums and workshops
- Encourage resource conservation education in schools

H. Use of the Conservation Element.

The Conservation Element is a public document intended to be used as a policy guidelines. It is expressly understood that the planning agency shall investigate and make recommendations to the Planning Commission upon reasonable and practical means for putting into effect the General Plan or part thereof, in order that it will serve as a pattern and guide for the orderly physical growth and development and the preservation and conservation of open space land of the County and as a basis for the efficient expenditure of its funds relating to the subjects of the general plan; the measures recommended may include plans, regulations, financial reports and capital budgets.

The purpose of such review is to avoid duplication of regulation, to fully evaluate the necessity for the proposal, and to preclude placing an unnecessary or excessive burden on either the public or private sectors of the consumer.

The result of such a review shall be public information in the interest of promoting public interest and understanding of the general plan and regulations relating to it.

COUNTY PLANNING COMMISSION

HAYWARD, CALIFORNIA

RESOLUTION NO. 11134 - At meeting held September 29, 1975

Introduced by Commissioner Lois Rusteika
Seconded by Commissioner James Zeno

WHEREAS pursuant to the provisions of the Planning Law (Title 7 of the Government Code) it is the function and duty of the County Planning Agency of Alameda County, California, to prepare and of the County Planning Commission to approve a comprehensive long-term general plan for the physical development of the County, such plan to be known as the General Plan, and to provide that the Board of Supervisors of Alameda County may adopt all or any part of said General Plan or any subject thereof for all or any part of the County; and

WHEREAS Alameda County has an official general plan entitled GENERAL PLAN, COUNTY OF ALAMEDA, STATE OF CALIFORNIA, approved by resolution of the County Planning Commission on July 26, 1965, and amended on December 27, 1966, June 16, 1969, September 17, 1973, January 14, 1974, and April 22, 1974, and adopted by the Board of Supervisors on May 26, 1966, and amended on February 23, 1967, August 28, 1969, December 18, 1973, January 29, 1974, June 6, 1974, October 10, 1974, and December 19, 1974, for the incorporated and unincorporated area of the County of Alameda including elements and other material listed above and proposals developed in the planning program sponsored by the cities within Alameda County; and

WHEREAS said Planning Law provides that a General Plan shall include a CONSERVATION ELEMENT, SEISMIC SAFETY ELEMENT, SAFETY ELEMENT, AND NOISE ELEMENT; and

WHEREAS the State Planning Law requires that a Conservation Element be adopted by December 31, 1973, and the State has granted an extension to Alameda County to September 20, 1975, to complete the Seismic Safety Element, Safety Element, and Noise Element; and

WHEREAS this County Planning Agency in coordination with cities and public and quasi-public agencies in the County has prepared a text containing objectives and principles and required maps for the above named elements for the incorporated and unincorporated areas of the County; and

WHEREAS this County Planning Commission on September 29, 1975, at a public hearing continued from September 15, September 2, and August 18, 1975, considered the proposed CONSERVATION ELEMENT, SEISMIC SAFETY ELEMENT, SAFETY ELEMENT, AND NOISE ELEMENT; and

WHEREAS public testimony was taken at the public hearings from those in favor of and those in opposition to the proposed plan changes: Now Therefore

BE IT RESOLVED that this Planning Commission recommends to the Board of Supervisors that the General Plan be amended to include the CONSERVATION ELEMENT, SEISMIC SAFETY ELEMENT, SAFETY ELEMENT, AND NOISE ELEMENT.

ADOPTED BY THE FOLLOWING VOTE:

AYES: Commissioners Enos, Rusteika, Zeno, and Chairman Carpenter.

NOES: Commissioners Kauffman and Spiliotopoulos.

ABSENT: None.

ABSTAINED: None.

WILLIAM H. FRALEY - PLANNING DIRECTOR & SECRETARY
COUNTY PLANNING COMMISSION OF ALAMEDA COUNTY

On motion of Supervisor Bort, Seconded by Supervisor Bates,
and approved by the following vote,
Ayes: Supervisors Bates, Bort and Chairman Cooper - 3
Noes: Supervisors Murphy and Santana - 2
Excused or Absent: Supervisors None

THE FOLLOWING RESOLUTION WAS ADOPTED: NUMBER 1 6 5 1 2 2

ADOPT CONSERVATION ELEMENT, SEISMIC SAFETY ELEMENT, SAFETY ELEMENT AND NOISE ELEMENT

WHEREAS, the Board of Supervisors of Alameda County held a noticed public hearing on January 8, 1976 as required by law on the Conservation Element, Seismic Safety Element, Safety Element and Noise Element of the General Plan of the County of Alameda;

NOW, THEREFORE, BE IT RESOLVED that this Board of Supervisors does hereby adopt said elements and concurs without modification of the Alameda County Planning Commission as set for in its resolution no. 11134, adopted on the 29th day of September, 1975.

ck

I CERTIFY THAT THE FOREGOING IS A CORRECT COPY OF A RESOLUTION ADOPTED BY THE BOARD OF SUPERVISORS, ALAMEDA COUNTY, CALIFORNIA JAN - 8 1976

ATTEST: JAN - 8 1976
JACK K. POOL, CLERK OF THE BOARD OF SUPERVISORS

BY: [signature]

THE COUNTY PLANNING COMMISSION OF ALAMEDA COUNTY
HAYWARD, CALIFORNIA

RESOLUTION NO. 76-120 - At meeting held September 13, 1976

Introduced by Commissioner George Spiliotopolous
Seconded by Commissioner William E. Carpenter

WHEREAS pursuant to the provisions of the Planning Law (Title 7 of the Government Code), it is the function and duty of the County Planning Agency to approve a comprehensive long-term general plan for the physical development of the County, such plan to be known as the General Plan, and to provide that the Board of Supervisors of Alameda County may adopt all or any part of said General Plan or any subject thereof for all or any part of the County; and

WHEREAS said Planning Law provides that a General Plan shall include a Conservation Element; and

WHEREAS the Board of Supervisors adopted a Conservation Element of the Alameda County General Plan by Resolution No. 165122 on January 8, 1976; and

WHEREAS this County Planning Agency in coordination with cities and public and quasi-public agencies in the County has prepared an amendment to said conservation element for the incorporated and unincorporated areas of the County as directed by the Alameda County Board of Supervisors on January 8, 1976; and

WHEREAS this County Planning Commission on September 13, 1976, at a public hearing continued from August 23, 1976 considered the proposed amendments to the CONSERVATION ELEMENT; and

WHEREAS public testimony was taken at the public hearings from those in favor of and those in opposition to the proposed plan changes: Now Therefore

BE IT RESOLVED that this Planning Commission recommends to the Board of Supervisors that the CONSERVATION ELEMENT, of the Alameda County General Plan be amended to include the proposed plan changes.

ADOPTED BY THE FOLLOWING VOTE:

AYES: Commissioners Carpenter, Enos, Kauffman, Bernhardt, Shockley, Spiliotopoulos, and Chariman Rusteika.

NOES: None.

ABSENT: None.

WILLIAM H. FRALEY - PLANNING DIRECTOR & SECRETARY
COUNTY PLANNING COMMISSION OF ALAMEDA COUNTY

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RICHARD J. MOORE, County Counsel

By .....[signature]..... Deputy

THE BOARD OF SUPERVISORS OF THE COUNTY OF ALAMEDA, STATE OF CALIFORNIA

On motion of Supervisor ..... Bort ....., Seconded by Supervisor ..... Bates .....,
and approved by the following vote,
Ayes: Supervisors ..... Bates, Bort, and Chairman Cooper - 3
Noes: Supervisors ..... None
Excused or ~~Absent~~ Supervisors ..... Murphy and Santana - 2

THE FOLLOWING RESOLUTION WAS ADOPTED: NUMBER 169797

AMEND CONSERVATION ELEMENT OF THE ALAMEDA COUNTY GENERAL PLAN

WHEREAS, this Board of Supervisors has received Resolution No. 76-120 from the County Planning Commission of Alameda County, relating to its intention to consider amendments to the official general plan entitled GENERAL PLAN, COUNTY OF ALAMEDA, STATE OF CALIFORNIA, to amend the Conservation Element; and

WHEREAS, pursuant to the provisions of the Planning Law (Title 7 of the Government Code), it is the function and duty of the County Planning Agency to approve a comprehensive long-term general plan for the physical development of the County, such plan to be known as the General Plan, and to provide that the Board of Supervisors of Alameda County may adopt all or any part of said General Plan or any subject thereof for all or any part of the County; and

WHEREAS, said Planning Law provides that a General Plan shall include a Conservation Element; and

WHEREAS, the Board of Supervisors adopted a Conservation Element of the Alameda County General Plan by Resolution No. 165122, adopted on January 8, 1976; and

WHEREAS, the County Planning Agency in coordination with cities and public and quasi-public agencies in the County has prepared an amendment to said conservation element for the incorporated and unincorporated areas of the County as directed by this Board on January 8, 1976; and

WHEREAS, the Alameda County Planning Commission on September 13, 1976, at a public hearing continued from August 23, 1976, considered the proposed amendments to the Conservation Element; and

WHEREAS, public testimony was taken at the public hearings from those in favor of and those in opposition to the proposed plan changes; and

WHEREAS, pursuant to the provisions of Section 65355 of the Government Code of the State of California, this Board held a public hearing on the above matter on November 23, 1976;

NOW, THEREFORE, BE IT RESOLVED that this Board of Supervisors does and it hereby adopts the amendments to the General Plan of the County of Alameda, State of California, to include the proposed plan changes in the CONSERVATION ELEMENT.

I CERTIFY THAT THE FOREGOING IS A CORRECT COPY OF A RESOLUTION ADOPTED BY THE BOARD OF SUPERVISORS, ALAMEDA COUNTY, CALIFORNIA NOV 23 1976

ATTEST: JUN 23 1977
JACK K. POOL, CLERK OF THE BOARD OF SUPERVISORS

BY: Shirley Dent